George Hardman:
Memoirs of Pioneer Work with the University of Nevada Agricultural Experiment Stations at Reno and Las Vegas, Nevada, and the U.S. Soil Conservation Service

Interviewee: George Hardman
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Description

George Hardman, a native of Oregon, was born near Prairie City in 1890. The son of a farmer, Mr. Hardman studied for a career in agriculture, receiving a master's degree from Oregon Agricultural College (later Oregon State College) in 1916. From 1918 to 1934, he was employed by the University of Nevada Agricultural Experiment Station, working in Reno or Las Vegas, and also as a member of the faculty at the university. Interests in soil conservation led to appointments as state coordinator for the U.S. Soil Conservation Service in Nevada, and in 1942, as State Conservationist. From June 1957 until 1967, Mr. Hardman was assistant director of the Nevada Department of Conservation and Natural Resources. He retired in 1967, recognized as one of the region's outstanding authorities in conservation. He is the author and coauthor of several studies on irrigation and soil amendment.

The memoir recorded by George Hardman includes accounts of his work with the Experiment Station farms at Reno and Las Vegas, teaching experiences at the University of Nevada College of Agriculture, work with the Soil Conservation Service and his role in establishing Soil Conservation Districts in Nevada, observations on various agricultural problems, and a philosophical conclusion.

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An Oral History Conducted by Mary Ellen Glass

University of Nevada Oral History Program

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Preface to the Digital Edition

Established in 1964, the University of Nevada Oral History Program (UNOHP) explores the remembered past through rigorous oral history interviewing, creating a record for present and future researchers. The program's collection of primary source oral histories is an important body of information about significant events, people, places, and activities in twentieth and twenty-first century Nevada and the West.

The UNOHP wishes to make the information in its oral histories accessible to a broad range of patrons. To achieve this goal, its transcripts must speak with an intelligible voice. However, no type font contains symbols for physical gestures and vocal modulations which are integral parts of verbal communication. When human speech is represented in print, stripped of these signals, the result can be a morass of seemingly tangled syntax and incomplete sentences—totally verbatim transcripts sometimes verge on incoherence. Therefore, this transcript has been lightly edited.

While taking great pains not to alter meaning in any way, the editor may have removed false starts, redundancies, and the "uhs," "ahs," and other noises with which speech is often liberally sprinkled; compressed some passages which, in unaltered form, misrepresent the chronicler's meaning; and relocated some material to place information in its intended context. Laughter is represented with [laughter] at the end of a sentence in which it occurs, and ellipses are used to indicate that a statement has been interrupted or is incomplete…or that there is a pause for dramatic effect.

As with all of our oral histories, while we can vouch for the authenticity of the interviews in the UNOHP collection, we advise readers to keep in mind that these are remembered pasts, and we do not claim that the recollections are entirely free of error. We can state, however, that the transcripts accurately reflect the oral history recordings on which they were based. Accordingly, each transcript should be approached with the

same prudence that the intelligent reader exercises when consulting government records, newspaper accounts, diaries, and other sources of historical information. All statements made here constitute the remembrance or opinions of the individuals who were interviewed, and not the opinions of the UNOHP.

In order to standardize the design of all UNOHP transcripts for the online database, most have been reformatted, a process that was completed in 2012. This document may therefore differ in appearance and pagination from earlier printed versions. Rather than compile entirely new indexes for each volume, the UNOHP has made each transcript fully searchable electronically. If a previous version of this volume existed, its original index has been appended to this document for reference only. A link to the entire catalog can be found online at http://oralhistory.unr.edu/.

For more information on the UNOHP or any of its publications, please contact the University of Nevada Oral History Program at Mail Stop 0324, University of Nevada, Reno, NV, 89557-0324 or by calling 775/784-6932.

Alicia Barber
Director, UNOHP
July 2012

Introduction

George Hardman is a native of Oregon, born near Prairie City in 1890. The son a farmer, Mr. Hardman studied for a career in agriculture, receiving a Master's Degree from Oregon Agricultural College (later Oregon State College) in 1916. From 1918 to 1934, he was employed by the University of Nevada Agricultural Experiment Station, working in Reno or Las Vegas, and also as a member of the faculty at the University. Interests in soil conservation led to appointments as state coordinator for the U.S. Soil Conservation Service in Nevada, and in 1942, as State Conservationist. From June, 1957, until 1967, Mr. Hardman was assistant director of the Nevada Department of Conservation and Natural Resources. He retired in 1967, recognized as one of the region's outstanding authorities in conservation. He is the author and co-author of several studies on irrigation and soil amendment.

When invited to participate in the Oral History Project of the Center for Western North American Studies, Mr. Hardman accepted graciously. Six taping sessions followed, all conducted at the Hardman home at 211 East Fifth Street, Carson City, between September 25 and November 7, 1967. Mr. Hardman was an enthusiastic and cooperative interviewee, formulating answers to questions and making observations with intense precision.

The memoir recorded by George Hardman includes accounts of his work with the Experiment Station farms at Reno and Las Vegas, teaching experiences at the University of Nevada College of Agriculture, work with the Soil Conservation Service and his role in establishing Soil Conservation Districts in Nevada, observations on various agricultural problems, and a philosophical conclusion. Some of Mr. Hardman's publications are footnoted in the text.

The Oral History Project of the Center for Western North American Studies attempts to preserve the past and the present for future research by tape-recording the reminiscences of persons who have played important roles

in the development of Nevada and the West. Scripts resulting from the interviews are deposited in the Nevada and the West Collection of the University of Nevada Library (Reno) and in the Special Collections Department of Nevada Southern University (Las Vegas). Permission to cite or quote from George Hardman's oral history may be obtained through the Center for Western North American Studies.

Mary Ellen Glass
University of Nevada
August, 1968

1

Beginnings of My Career

I'll start with my birth, February 15, 1890, near Prairie City, Oregon. My father was the son of an early settler on Strawberry Creek which is a branch of John Day River. My mother was the daughter of a Civil War veteran who moved to eastern Oregon from Mississippi after 1865. That country was, and is, a stock-raising country, and Father followed livestock, mostly cattle, near Prairie City, or on Burnt River which was some forty or fifty miles away.

Father moved the family to Ontario, Oregon, in 1902 where I started to grammar school. Prior to this I had had probably six or seven weeks of formal education. My brother, five years younger than I, started to first grade at the same time that I started in the fourth grade. I was graduated from high school in the spring of 1910 and entered the Oregon Agricultural College, in the fall of that year. The freshman class that year was about five hundred in number which was about equal to the enrollment of the upper three classes, so the enrollment of Oregon State College, or Oregon Agricultural College at that time, was about one thousand. I was graduated from Oregon State College, rather Oregon Agricultural College—it was still Oregon Agricultural College in 1915- -with a Bachelor of Science degree in Agriculture.

I spent the summer of 1915 on field work on a project for the determination of the use of water by field crops. This work was under the direction of W. L. Powers who was the soil scientist and irrigation engineer for the College of Agriculture.

In the spring semester of 1916, I took several advanced courses and wrote a thesis on the 1915 field work. From the thesis and the graduate studies I was given a Master of Science degree in Agriculture in June of 1916.

Why did I decide on an agricultural career? I was raised on a farm and always had the idea in mind of being a farmer, I guess, because of the family background. Looking backward, it seems that there were influences which seemed to say this was the thing to do at the time. I had one year after I left college in which I was in commercial work on the farm and for the Goose Lake Irrigation Company.

The money that you could make farming in those days was pretty small. The money that you could make following a professional career was a little better—seemed a little better. Then I got an opportunity to come to Reno during the winter, probably in about April, of 1918. So I came. The job was a good deal better than the one I had in Lakeview, Oregon, as far as pay went. In those days, one hundred dollars per month was a pretty big salary, a pretty good salary.

University of Nevada
The College of Agriculture

S. B. Doten, the director of the Experiment Station in Reno got me to come down. I was immediately put in charge of the Agricultural Experiment Station Farm which is now known as the Valley Road Farm, across from the fairgrounds here in Reno.

Not too many of the young students who gave any promise of doing scientific work at all ever went back to the farm in those early days. It was the trend, the tendency, because farming was not considered to be a very high profession, and it wasn't a very highly paying profession in those early days. At the turn of the century you remember, there was quite a depression in farming. In eastern Oregon, where I was a resident, farming was in the dumps- -very low.

Well, Mr. Doten put me in charge of this Experiment Station Farm and some of the work of the station, and I was soon placed part time on the faculty of the University. In 1918 there were no Ag students. The war was still on and there were very few students at the University. In 1919 they began to come back. The classes were pretty good size.

I taught the spring semester of 1919. Then I went up to the Humboldt with F. L. Bixby, who was a civil engineer, representing the federal agency called Irrigation Investigations. Bixby was located at Reno. He and I cooperated on some investigations on the Humboldt River. In the fall of 1919, I returned to Reno and taught irrigation, soils, and farm mechanics.

On the faculty of the College of Agriculture at that time was Dean C. S. Knight, who was replaced a year or so later by Dean Robert Stewart. Knight was an agronomist. Stewart was a chemist and soils specialist. C. E. Wilson taught animal husbandry. Verner E. Scott taught dairying. I taught irrigation and farm mechanics. Phil Lehenbauer was in charge of the horticulture section. There was also one stenographer in the department.

We had a very strong course in bacteriology in the College of Agriculture. You'll find that in those days they had a pre-medic course. Peter Frandsen was the bacteriologist, and he was a whale of a teacher! His students went to medical schools like Stanford and so forth, and they were always at the top in the first two years of work. Sears was the chemist and taught the chemistry courses.

The College of Agriculture gave a fairly rounded course, but it didn't specialize in anything. We had a great deal of difficulty later in qualifying agricultural students for civil service positions because of the lack of specialization. There weren't enough teachers in soils, or in range management, or in other fields to make specialists out of any of the students. I think the College of Agriculture is still having somewhat of a problem, but it has been at least recognized to some degree.

In the Experiment Station were S. B. Doten, Director; Charlie Fleming in charge of the Department of Animal Husbandry, I think it was called. Mostly, Charlie's work in those early days was on poisonous plants. F. B. Headley was in charge of the Experiment Station Farm at Fallon and later transferred to Reno. F. L. Bixby was the representative of the

Federal Division of Irrigation Investigations. Dr. Church was in charge of the snow survey work. That was about the personnel of the Experiment Station, except for the secretaries.

Dr. Church, as you probably recall, was in the College of Arts and Science. He was a Greek and Latin teacher, really in art appreciation, but he was also in the Experiment Station as the leader of the snow survey work which was underway, well underway, by 1918.

Two items occur to me in regard to Dr. Church which may be of interest. One is that throughout his lifetime, Dr. Church never learned to drive an automobile. The second item is that in spite of the rather frequent urging on the part of Director Doten, Dr. Church wrote only one bulletin for the Agricultural Experiment Station. Nevertheless, the Agricultural Experiment Station in Nevada received favorable notices from Dr. Church's work, and probably the amount of such notice obtained by the Station, without a single bulletin by Dr. Church, was as great or greater than that obtained by any department in the Station. For this reason, Director Doten was inclined to overlook Dr. Church's failure to write bulletins.

Throughout Dr. Church's career, Professor Jeff Boardman assisted on the mathematics. Most of the mathematics of Dr. Church was developed by Boardman. Very little attention was given, or has been given, to Professor Boardman's collaboration with Dr. Church. If bulletins had been written and published by Dr. Church, undoubtedly the work of Jeff Boardman would have been more fully recognized.

The Agricultural Experiment Station got no state appropriation. A small amount of money came into the Experiment Station from the sale of products, crops, and so forth. But the principal source of income was the federal government.

There was little change in the College of Agriculture during the next six years. Among the early students who became associated with the University were Eldon Wittwer, Dr. Eldon Wittwer he became later, who became dean of the college; Tom Buckman, Howard McKissick, Sr., presently a member of the Washoe County Commissioners; Al Reed, who later became the county agent who was located at Yerington and later at Lovelock. Those were all among the early students. I could name others, but those were the ones that come to mind quickly and readily.

During the war time, Dean Knight prepared a number of circulars and one bulletin on field crops. I assisted the dean in preparing a number of these publications, but the bulletin was the only one that either the dean or I really thought had any lasting possibilities.*

Cecil W. Creel came to the Experiment Station a while after the Agricultural Extension was organized and became director. Charlie Norcross was the first director. He resigned and left the Station before Cecil Creel appeared on the scene.

Director Doten of the Experiment Station was an extremely good public speaker, but he disliked to travel. For that reason he assigned many of the state meetings, such as the State Farm Bureau, to members of the staff of the Experiment Station. And it happened that many times I was the person designated to attend State Farm Bureau meetings. Because of this, I became acquainted with the many of the leaders in the Farm Bureau, both the professional workers and the county officials who were interested in agricultural work. I was particularly closely associated with John

*See Bulletin No. 96 (1918), "Irrigation of Field Crops in Nevada."

Wittwer, who was county agent in Clark and Lincoln Counties for many years, and with the officials in these two counties.

Mr. Creel was a particularly effective public speaker and made a fine appearance. He was interested in national affairs, and represented the American National Farm Bureau in Washington for a period of time. During his absence, Mr. Thomas Buckman was acting director of the Agricultural Extension Service. Shortly after Mr. Creel's return to Nevada, he resigned from the Extension Service and retired to private life, but continued to work through a number of federal appointments.

The Agricultural Extension Service and the College of Agriculture went through a period of reorganization after 1940, or somewhere around there. Dr. A. R. Bertrand was the first overall dean who had charge of the Extension, Experiment Station, and the College of Agriculture. Dr. Bertrand resigned and was followed shortly afterwards by Dean James Adams, who resigned later and was followed by Dean Dale Bohmont. At the moment Bohmont is Dean of the College of Agriculture, Director of Extension, and Director of the Agricultural Experiment Station. Extension is directly under an assistant director and the Experiment Station is likewise under a representative of the dean, who is in direct charge.

President Clark became president of the University of Nevada along about 1917. He was a good president, an effervescent type of an individual. He was a good speaker and made a fine public appearance. I thought the University prospered under Clark. I liked him personally very much. I was not so well acquainted with other presidents that followed Clark. Hartman? Yes, I knew him very well. He was professor of physics and then became president. My daughter was his private secretary for many years. She left the University to enter the WAC's—was a pilot in the WAC's.

Since the years before 1925, the years that I was teaching, there have been some changes in the way things are approached. I don't think there have been any basic changes, but there has been more thought given to integrating different fields in the College of Agriculture. In other words—soils, for instance, is thought of as a broad field now, whereas in the early days there were courses given that didn't necessarily lead to a comprehensive view or understanding of the field. There was, I think in those early days, more of a tendency to teach a course without regard to how it fit into the overall education of the individual. We had some good teachers, some of the very finest, Professor Sears in Chemistry for instance; we had excellent courses in Physics under Hartman, and there were good courses, in all the colleges that the Agricultural College was associated with, but there was no great degree of specialization. There was more of a general kind of an agricultural course. It didn't equip students to specialize in any one field—for instance, in animal husbandry, or dairy husbandry, or field crops, or any of those fields that the Civil Service Commission recognizes, therefore there was great difficulty in qualifying students for employment in federal occupations. I know that a great deal of effort has been made more recently to give more specialization and to give courses which would qualify students to take examinations in the field that the federal Civil Service Commission recognizes, for instance, in range-management or in soils or in conservation, and so forth.

The equipment of the College of Agriculture to give courses, both in personnel and in the physical equipment, has been increased a great deal. There was very little

in the early days. There was a person and he created whatever course was to be given; So there was a great deal of dependence placed upon individuals.

Many of the problems that Nevada has in soils and water management and in crops are approached more on the field level than they were approached at the university course level because they are special problems. If any individual teaching courses at the University tried to introduce these problems into his courses, he'd soon be swamped. Now, some of the major problems have been introduced into teaching—the overall things—but there's no way that I know of that you can introduce all of the special problems into teaching. You can teach basic principles to fit the student to meet any kind of problem. I think that's pretty much the plan for teaching at the present time.

Many of the special problems have received consideration by the Experiment Station. The poisonous plant problem, for instance, has received a lot of consideration. The matter of how to manage the ranges received consideration by the Experiment Station, from economic studies and from physical studies.

We had a number of outstanding young people in our classes. They subsequently became involved in university work. Tom Buckman and Eldon Wittwer, for instance, became involved in trying to answer some of the questions in water problems which involves engineering and crops and soils and so forth. Many of the men who became well-known in water engineering were students of engineering, not students in agriculture. Among those I would say, there've been a number of students at the University of Nevada. A. M. Smith, for instance, and Senator Molly Malone (George W. Malone) were students at the University at the College of Engineering. They became nationally well-known. A. M. (Tom) Smith was one of the early leaders that I knew. He was an extremely big man. He was about six feet seven inches. That's pretty tall. I can remember one instance when Tom Smith was on a platform with a governor from—I believe it was Wyoming-who prided himself greatly in the fact that he was very tall. They stood together on the platform, and Tom was about an inch. taller. He was a great man as well as being a good State Engineer. He was a great administrator.

Malone was extremely personable and became a national figure, a national leader. None of the State Engineers were students in the College of Agriculture.

Agricultural Experiment Station Work on the Humboldt River

The Agricultural Experiment Station carried on investigations on the Humboldt under myself and Fred Bixby in 1919, 1920, 1921. The Humboldt, as most rivers an the state, is subject to extreme variations in runoff. It will have years of extremely high waters and a large volume; sometimes high water years occur in groups so that succeeding seasons will have high runoff, and then there will be periods of low runoff, low flood stages; maybe those will occur several years in succession. Our investigations led to the conclusion that without more complete control of floods, and runoff, and so forth, the only changes that might be effective in the cropping systems on the Humboldt would be changes that could be made along the margins of the big meadows, the main meadows that were flooded during a high water period. Little change could be effected.

In the early twenties, there was no major change in control of Humboldt River apparent at all. Therefore, the Experiment Station felt that further work was not likely

to yield profitable returns. Therefore, the investigations on the Humboldt River system were dropped. The Experiment Station then took up the problems in southern Nevada—pumping from underground water sources, the improvements in soils, cropping with fertilizers, and so forth, as the main problems.

Nevada, as a whole, is subjected to periods of high precipitation and periods of low precipitation. Some of these phenomena were investigated later. Prior to about 1940, there had been no reasonably good rainfall map of the state. Such a first effort to produce a realistic rainfall map was made by myself and others about 1940. This map has been revised a number of times in succeeding years. The subject is under present investigation by the Desert Research Institute as well as the Department of Conservation and Natural Resources.

Since the Agricultural Experiment Station had found that there was no use in going into the projects and experiments along the Humboldt, why did the Bureau of Reclamation come in with the Rye Patch Project? Well, the Bureau had been encouraged for a number of years by our representatives in Congress, Representative Scrugham and Senator McCarran, to find some project in Nevada, because nothing had been done in the state since the Newlands Reclamation Project. The Bureau investigated possibilities for storage of water on the Humboldt River from the headwaters to the end of the river near Lovelock. It decided that the Lovelock Valley could utilize a better supply of water and that there was a possibility for the storage of flood flows above Lovelock Valley. As a result, the Rye Patch Reservoir was promoted as a reclamation project and the Rye Patch Dam was built.

Slightly better runoff conditions followed the building of the dam along about 1935-'36 so that storage of water was begun about 1936 and a reasonably full supply of water was provided to the Lovelock Valley after 1937. The building of the dam of Rye Patch did nothing to change the conditions on the main irrigated areas of Humboldt River. The meadows in this area have continued to be irrigated by controlled flooding- -pretty much as they have throughout history. Lovelock Valley, on the other hand, with the reservoir, has developed a more diversified type of agriculture. Climatically, the area is adapted to production of alfalfa, grain, potatoes, and other cultivated crops which some of the valleys higher up the Humboldt River are not.

In the Lovelock Valley we dealt somewhat with soil conservation problems. Soil erosion in the Lovelock Valley is confined pretty much to washing along the channel of the main stream, but there have been changes in the soil due to water logging and the rise of alkali. This occurred following the building of the Rye Patch Dam because the Lovelock Valley, after that, had a long flow of water and this permitted irrigation for a long season and the consequent development of a high water table.

The Pershing County Water Conservation District and the Bureau of Reclamation have done a great deal to alleviate this condition by the construction of drainage ditches.

The Soil Conservation Service did some work with individual farmers prior to the organization of the soil conservation district in that valley. They did a great deal of good, I think, in systematizing reclamation of some of the lands by land leveling and removing alkali and prevention of the formation of a high water table. All of this work in Lovelock Valley is continuing at the present time. It is a very productive area and produces high-yielding crops of alfalfa, grain, and sugar beets, and so forth.

On the headwaters of Humboldt River, irrigated land has seen little change. Wherever the conditions made possible better irrigation and so forth, there have been changes. According to the State Engineer, some of these changes have made distribution problems on the Humboldt more difficult.

A survey was made of Elko and part of Eureka and Lander counties in 1936, by a combination of federal and state agencies which included the Soil Conservation Service, Grazing Service, Indian Service, the old ACP (Agricultural Conservation Practices), and the Experiment Station. One of the sideline investigations was carried out by the county agent in Elko County, Joe Wilson. He traced many of the water courses of the headwaters of the Humboldt River and found that there was active erosion in many of the channels. He felt that this was due to overgrazing by bands of sheep in the '20's to the '30's, and continuous grazing by cattle to the present time.

There are early records which indicate that trout lived and multiplied in the early days in Humbolt River. There have been no trout in the Humboldt River, for the last fifty years at least. In some of the deeper waterholes below the many irrigation dams on the river, there are bass. There's little opportunity or little prospect that the trout can ever be restored because there are too many dams in the river and too much of the water is diverted for irrigation. Even in some of the headwaters of the stream, diversions for irrigation have lessened the low flow, and many of the stream channels are choked with sand. What were trout streams thirty years ago or forty years ago, no longer support any trout.

Some of the areas near the headwaters of Mary's River, the headwaters of north fork of the river, and so forth, were great sagehen areas before 1920. Most of the sagehen have disappeared for various reasons. Overgrazing of the lands, particularly around the waterholes, has been credited with responsibility for disappearance of the sagehen.

Hunting pressure is much greater today than it was in the early days. Along the Humboldt River itself, wildlife of any kind was scarce and always has been scarce. The beaver were taken out of the stream very early. Probably most of the beaver were eliminated before real settlement took place. Probably the beaver was the most plentiful of all the wildlife in the early days. The beaver have returned to many areas of the river, which had feed for them, in the last fifteen to twenty years, and became quite a problem in certain areas. The State Fish and Game Commission and the State Engineer have worked together to alleviate the damage to crop lands caused by beaver.

Deer were not plentiful on the Humboldt River or any place in the state of Nevada, for that matter, when I came to the state in 1918. There were a few here and there, but the numbers were not great. The number of deer has *increased* over the years with protection, and with the elimination of market hunting. There were no game laws in the early history of the state, and there was a great deal of marketing of deer and sagehen and trout. The old newspapers, even as late as 1870, contained items regarding menus in the restaurants in Elko, and Battle Mountain, and other eating places, which described trout, deer, sagehen—as a delicacy, you understand. I have eaten Pyramid Lake trout in the restaurants in Reno, and the history of the time indicates that there were tons of these fish shipped to San Francisco, and other places. Probably there are more deer today on the ranges in Nevada than there ever were in the early days. I don't think it's any question but what there are more.

Fish? That's another story—there's no way of reversing the effects of irrigation. Streams are diverted, dams are built and the fish disappear. You can't go backwards.

On the newer reclamation projects, an effort is being made to provide permanent water in which fish can live. On the Humboldt, the Corps of Engineers, U. S. Army, has planned three large reservoirs. Those are on Mary's River, on the south fork of Humboldt River, and the north fork of Humboldt River, all of which would not only store flood waters, but would have a reserve for recreation, fish, and wildlife. If these are ever built, their presence would make possible some changes in agriculture along the Humboldt River. Since they would involve changes, there has been opposition. Other than possible effects on fish, chances are they would not involve other wildlife.

Most of the changes in vegetation on the range lands occurred or were well underway when I came to the state in 1918. Certainly when I began to work on the Humboldt in 1920-21, those changes on the range lands were pretty well underway. Those had been described by various writers as starting way back in 1870-1880, and mostly they have concerned the elimination of some of the grass species- -and the replacement of those with sagebrush or in some cases with other types of herbaceous plants, rabbit brush, for instance.

Well, the work on the Humboldt River was somewhat disappointing. We did report every year what was done, but low water years and high water years tended to make any improvement on the bottom lands, which were the irrigated lands, very difficult. One year I seeded a number of plots with improved grasses , the idea being that we might be able to improve the yield of the native meadows, and we got a beautiful start. Everything was lovely early in the spring, but a high water year came along and those meadows were covered with water for several weeks. When the water finally receded, there were no grasses left.

Well, the Experiment Station did not have the facilities and money and so forth to go into a big experimental setup on the Humboldt River, and at that time we didn't know about some of these things that have come along more recently. So, in 1922, Director Doten made a decision to start some work in Clark County, in southern Nevada, principally on investigations on the yield on some of the wells in the area. We had very little in the way of facilities, but we did some preliminary work and some pumping in 1922. That was the first summer that we spent in the territory.

2

The Las Vegas Years

I returned to Reno in the fall of 1922 and taught the spring semester. Then I went back to Las Vegas in 1923 and continued with the pumping work with some additional equipment and assistance from Mr. Bixby. The Irrigation Investigations gave us the assistance of an engineer named Walter Stockwell. He stayed with us for several years.

I taught in the spring semester of 1924 and then again went to Las Vegas. I spent the summer in Las Vegas, again returning to Reno in the winter of 1924, taught courses that year, the spring term, and returned to Las Vegas in 1925.

Congress, in 1925, increased the funds for the Agricultural Experiment Station which permitted it to plan new projects. During the previous three summers, I had done some work in cooperation with the county agent, John Wittwer, with fertilizers and soil amendments. This work was carried on with pots, old tin cans, anything we could find to work with, but the work indicated that under certain conditions we could expect results.

Now, it is about 450 miles from Reno to Las Vegas. The roads then were natural roads and it took about two days of hard travel to go between the two towns. Movement back and forth was difficult. It was expensive for the Experiment Station and *it* paid all the bills. So Mr. Doten decided, under the circumstances, with this additional money beginning in 1925, that it might be better to either stay in Reno and teach, or go to Las Vegas and stay there. Well, I decided that the prospects looked pretty good in Las Vegas. I was established there pretty well by that time and so I went to Las Vegas to stay.

The Union Pacific Railroad gave us ten acres of ground on which to lay out a series of experiments, which we did. Water was obtained from the railroad, so we were all set. In the summer of 1925, we laid out a series of experiments which were designed for about a ten-year period, and that's what they turned out to be. The results of all that work were finally published in a bulletin by the Experiment Station, but not until after

I had undertaken certain other projects in Reno.*

We had done a great deal of water measurements and pressure measurements on the wells, before 1925. Harry Jameson had been assisting me on that. He was an extra fine man in charge of the actual work on the Experiment Station farm. I did the head work and the desk work. Harry stayed with us throughout that ten-year period on the Experiment Station. We took this piece of raw land which is now part of the Las Vegas cemetery, reclaimed it, laid it out, carried on our experiments with fertilizers and farm manures. Manures we obtained from the old Las Vegas farm which was a dairy farm at that time. We knew very little about the use of gypsum, but fortunately the waters of the Las Vegas valley and the waters we were using on the farm were pretty high in gypsum. So, with the use of plenty of water to wash out the alkali and applications of phosphorus to supply the shortage of phosphorus in the soil we were able to raise excellent crops. We did show that you could produce alfalfa more than two or three years on those lands.

On the better lands of the Moapa Valley and the Virgin Valley, the applications of phosphorus didn't show up so well, but they did show enough so that the entire southern region, which is a limestone area, is now a user of treble super phosphate, or triple super phosphate as you should call it. "Treble super" is a name that was patented by a Canadian firm, but we always called it treble. It is a development of the old super phosphate. Old super phosphate is merely bone, ground up and treated with sulphuric acid to make the phosphorus available. If the treatment is continued with the use of phosphoric acid, you can continue to build up the phosphoric acid content and get a mixture richer in phosphorus. Treble super is about as far as you could go. We could afford to ship treble super phosphate from Anaconda, Montana, for use on, say, alfalfa or other crops in southern Nevada. It stimulated the growth of alfalfa from less than a ton per cutting in southern Nevada, where we ordinarily cut about six times a year, to where the yield was about double. If you can cut somewhat over a ton per acre, you can afford the routine work of harvesting a crop. If you cut less than a ton, the cost of handling it is about equal to the value of the crop.

We did not attempt any of the duty-of-water studies in southern Nevada. The reasons, well, there were several. One thing was the water supply; second, perhaps the *pressing* problem seemed to be production. Many of the lands in southern Nevada would grow alfalfa for two or three years and then the crop would apparently fade out. Just wouldn't produce. Well, if alfalfa doesn't produce (that's the basic crop for all of that country) no other crop would do very good.

The supply of phosphorus was not adequate. We didn't recognize that in the Experiment Station, nor was it recognized generally. In truth, the fact that there was a shortage of phosphorus was vigorously opposed, but we found many indications of phosphorus deficiencies after we began to look into the situation. The crops were small. The manure produced in Moapa

*See Bulletin No. 112 (1928), "The Development of Water Supplies for Irrigation in Nevada by Pumping from Underground Sources." Also Bulletin No. 136 (1934), "The Quality of the Waters of Southeastern Nevada, Drainage Basins, and Water Resources," and Bulletin No. 171 (1944), "Fertilizers and Manures in the Improvement and Maintenance of Soil Productivity in Southern Nevada."

Valley, for instance, appeared to do no good when applied to the land, which is contrary to normal anticipations. The people were subject to broken bones that didn't heal. Livestock didn't produce. Dairies were not very successful because you couldn't get the cows pregnant. I have seen flocks of chickens become cannibalistic and begin chewing each other to death. There were sheep where the pasture was good which would break down in the backs and die in the field of broken bones—spontaneous breakage and fractures.

John Wittwer and myself had experts from the University of Nevada and other universities come in and study this problem. We couldn't understand why phosphorus was not giving returns because there had been many tests with ordinary super phosphate with no returns! Then we accidentally discovered this treble super phosphate which contains eighteen percent or so of P205. The extra phosphorus in treble super phosphate overcame the tendency of the limestone soils to absorb the little phosphorus that was contained in ordinary phosphates. Then we began to get results.

I fertilized a small block of pasture through a big field, and then had the farmer turn his sheep on the pasture. The sheep would concentrate on this little block, this little field of this fertilized stuff, and leave good pasture on either side. They would leave the field and go out and browse around on the hills where no grass grew, rather than eat this phosphorus deficient feed. Mr. Wittwer and I—(because remember in all of these things outside of work on the Experiment Station, John Wittwer was the leading spirit and the guy that I worked with)—sent many of the samples of these fertilized and unfertilized crops to M. R. Miller, the chemist at the Experiment Station in Reno, for analyses. He analyzed them and he came back with results that showed the increase in phosphorus was tremendous in the fertilized feeds. That was the big reason why we went into experiments, tests, and so forth, to introduce phosphorus into this area rather than studies of the water requirements. There wasn't any great demand in southern Nevada for this other type of work.*

There were other incidental crops—tomatoes, for instance. Why is the tomato crop so poor in southern Nevada? Well, one thing was phosphorous. We could produce a tomato crop if we fertilized and covered it, but the little white fly that bothers the sugar beets would come in, and they carry the virus of a disease which got into the tomatoes and killed the plants. You can overcome that partly by shading, but that's a bothersome way. The only way is to enclose 'em so that the bug can't get at the plants. We raised tomatoes, but not very successfully.

John Wittwer's tests and experiments on tomatoes has resulted in the production of tomatoes under cover. Robert A. Griffith and his associates are producing tomatoes by growing in plastic covered buildings.

Well, the work on the Experiment Farm led to demonstrations by farmers over the whole of southern Nevada. Those demonstrations were organized by John Wittwer.

We kept up the well measurements through those years because a lot of the measurements could be made during the wintertime when work on the farm was at a low ebb. About 1934, the water supply of the old Las Vegas ranch, the Union Pacific Railroad, and Las Vegas was becoming short.

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*See Bulletin No. 171 (1944), "Fertilizers and Manure in the Improvement and Maintenance of Soil Productivity in Southern Nevada."

The Union Pacific did not want any wells drilled on any of their lands because that might drain the springs. The Union Pacific was experiencing difficulties in supplying Las Vegas with water, and the Experiment Station and the farm were secondary to their main objective—the city water supply. Mr. Doten and I decided that we should close up that series of experiments.* So in 1934, I was transferred back to Reno. Mr. Jameson, after we closed up the farm was employed by Hugh Shamberger and Dr. George B. Maxey on further investigation of the water supply. He has since passed on.

Memories of Las Vegas in the 1920's and Travel on Early Nevada Roads

In those early years, in 1925,—'26, '27—along in the middle twenties, people were thinking about southern Nevada from an agricultural standpoint. It wasn't until after Boulder Dam, which was authorized in 1929, and finished in 1937 and began to produce power, that the people of southern Nevada began to think more about recreation and gambling. There isn't too much except the lake itself, Lake Mead, in the way of recreational opportunities. Oh, the desert and beautiful mountains and scenery, and that kind of thing. But until recreation came of age, agriculture was supposed to be the basis of the economy of the area. The railroad had always been a big factor because they had a big payroll in Las Vegas. The *old* Las Vegas, before 1929 was supported almost entirely by the railroad payroll. I believe it was about 1925 the first pavement was laid—that was a little section down Fremont Street in Las Vegas. It was paid for cooperatively by the Bureau of Public Roads and the State Highway Department because the city of Las Vegas qualified as a rural community, that is with less than 2,500 population. It was a nice town in those days, nevertheless.

My wife and I knew practically everybody in Las Vegas. I operated the experimental farm. Mom operated a beauty shop. Probably you don't know about marcelling. Well, Mom was an expert at that job, and in that country it was good because it is a hot country. There was electricity, but it was expensive.

There were no cooling systems because all we knew about at that time was so-called swamp coolers. We didn't have a swamp cooler. The cost of electricity for running one of those things was pretty high. A lot of trouble has been caused in Las Vegas by those coolers because they waste the water. They use some water, naturally, in evaporation and then the water runs off and gets into the ground. Of recent years Las Vegas has outlawed them unless you have a return system, that is you have to have a sump and a pump to pump the water to the cooler. That's not very satisfactory, so many of the people in recent years have gone to mechanical refrigeration for cooling, and that takes power.

In those early days recreation consisted of Saturday night dances and swimming parties practically every night. We almost lived in the swimming pool for a long time in the summertime. There's nothing nicer than water unless you get an ear infection or something like that. That's about the only thing that bothers you. You couldn't ride very far. No place to go and then the roads were rough. It was about 1929 when they began to oil the roads. They tried many things, calcium chloride, ordinary salt, and sodium sulphate, and so forth, but they found in that

*See Bulletin No. 136 (1934), "Quality of Waters in Southeastern Nevada, Drainage Basins and Water Resources."

dry climate nothing would hold the gravels and fine materials. So the cost of replacing gravel every little while was equal or greater than that of the oil that might hold the gravel for quite a long while. So they first began to oil the roads, then gradually in '32, and '33, and '34, along in those years, they began to put in pavements.

When we moved from Las Vegas to Reno in 1934, most of the road was paved. Gee, that was wonderful!

In the 1900's, 1918 on up to 1930, the road, for instance, from Reno to Elko, would become almost impassable every fall. It'd become so bad that people would put their cars on the railroad and ship 'em across the state and over to Sacramento rather than to drive them. And I have seen good cars abandoned out on the road. The drivers would become exhausted trying to buck those bad roads and leave their cars. In those days nobody bothered the cars. They could set there for months and would be perfectly all right when the driver came back to get the cars or send somebody to get them.. They would be just as good as they were when left.

But the roads were terrific. I used to figure in the spring of the year when the roads were pretty good, I'd drive from Reno to Battle Mountain. In the fall of the year when the roads were bad, it'd take two days. Now it takes a few hours. Four hours at the most. We used to figure that if we could drive to Lovelock in two hours, that's a hundred miles, and that was pretty good time. The road to Battle Mountain followed the old railroad grade most of the way, and it was kinda rough. All of the country roads were the same; they were just graded out of the old trails, really. The average speed in traveling over the state would be about twenty-five miles an hour. You could sometimes exceed that and sometimes you'd be a great deal under. Sometimes you'd hit stretches where you could walk faster than you could drive a car. One of the passengers would get out and walk and see if he couldn't find a better path for the car to follow. That was not mud, but dust-dust only.

From Winnemucca to McDermitt, which is now a little over an hour's drive, used to take a full half-day. That was one of the reasons why in the early days all the livestock, cattle and sheep, were driven from place to place; the roads were so bad that you couldn't afford to truck them. Trucks made such poor progress that they had to charge such high rates. Now, most of the movement of sheep any distance at all is by truck. Cattle go to market by truck rather than by the railroad. They can make time and they put the livestock right where you want 'em—where they are fed, or finally disposed of.

Las Vegas Water Problems

The Union Pacific Railroad started Las Vegas about 1907, principally because of the big springs there, the Las Vegas springs. The Union Pacific Railroad, through a subsidiary of the company, the Las Vegas Water Company, supplied water to all of the town that was laid out by the railroad. The springs furnished an ample supply of water with considerable surplus which went down to the Las Vegas ranch, the "old ranch" they called it in those years, where it irrigated a considerable area of land. By 1924-25 the town had grown. The springs were not capable at all times of supplying plenty of water. So they began to use wells. The big well which the Union Pacific railroad put in, which was put in about 1925, had a magnificent flow, about eight second feet of water, but it did affect the flow of other wells within a mile or so. And it cut down the flow of the Las Vegas springs to

some extent. From then on, I would say there has been a problem.

The Union Pacific Railroad has given up the Las Vegas Water Company, I'm not sure just when, but it occurred not too long ago. The entire system was then taken over by the Las Vegas Water Company, which now controls the Las Vegas springs and all the wells and all the system that supplies Las Vegas. North Las Vegas has its own water company and the water is derived largely from wells. The towns of Henderson and Boulder City have their own water companies with the supply coming from Lake Mead.

I would say that beginning about 1924-25, Las Vegas was increasingly conscious of the shortage of water in that valley. By 1934 there were probably two hundred wells in the entire area. I don't know how many there are now. Dr. Maxey could furnish that figure,. I'm sure, but it's hundreds of wells.

For many years now, the State Engineer has refused to grant permanent water rights in the Las Vegas area. He does give temporary water rights for domestic wells and they are supposed to be good only until water can be supplied from the Colorado River. That is a big federal project that has been approved, and the money's been allocated. It is in the planning stage and is supposed to deliver water to the Las Vegas valley in about three or four years.

Well, as early as 1925, John Wittwer, Bixby, and I had been making some preliminary studies of the recharge of water to Las Vegas valley. Those studies have been continued by Dr. Maxey and others to the present time. They've been refined a great deal. The early studies indicated water supplies of, say, forty thousand acre feet. Later studies have cut that estimate to twenty-five to thirty thousand acre-feet. The wells in Las Vegas that were previously flowing are now all pumped. The water table has been dropping at the rate of about two feet a year. I don't know when it might reach a pumping depth that would be uneconomical because I don't know what is uneconomical for a big resort area. But anyway, the use of water in the valley has far exceeded the annual replenishment or recharge. It's doubled, probably. That is the real background pressure for pumping from the Colorado River.

Colorado River Water Litigation

We didn't know in 1957 that Las Vegas was going to become a town with a population of a million or more, but we had some ideas. Mr. Shamberger got experts to come in to appraise the situation. They couldn't believe that the rate of growth would continue through 1968 and '69 and reach up to a million by 1970. I don't know whether it will or not, but the population which was projected during this Colorado water suit for 2000 has been reached in Las Vegas in 1967.

I noticed by the newspapers that Mr. Howard Hughes thinks that Las Vegas will have a population of a million. I don't know when that is, but if growth continues, it will reach a million. That means that all the water that can possibly be channeled into Las Vegas valley will be used by people rather than by agriculture. Agriculture will become secondary at least. Industry and people, lawns, yards, and so forth; there will be many gardens, flowers, and all that kind of stuff produced, that take water. But that will be really for people's own enjoyment, and not a commercial thing.

In 1957, when I transferred to the state to work on the Colorado River suit, the idea was still held that water rights must be attached to land because in all the history of water, the first right attached it to land. Then from

land, it may go over to a city water supply and to people, but there was no mechanism to attach a water right directly to people; there isn't yet, as a matter of fact. We recognize that people must be provided with water, and we recognize that recreation must be provided with water, but how do you get a water right transferred from a source to people? It's a little problem that engineers, lawyers, and courts are still wrestling with.

The Bureau of Reclamation is recognizing that problem. The Las Vegas water supply project is a Bureau of Reclamation Project for pumping of whatever quantity of water is finally decided as necessary for the people in Las Vegas valley. The total pump lift is near two thousand feet. The water will not be for agriculture, but for *people*. The federal Bureau of Reclamation was one of the first agencies to recognize that people *do* require water, and that water rights can be held for the use of people rather than for use on pieces of land. Reno has that problem. The water company is transferring many water rights from land, as they pick up the land. And they're using that water for people, in houses, on lots, and so forth. You know how people use water!

So, in the beginning of this Colorado River suit, there was a great effort made to find land on which water could be used. Back in the days when Boulder Dam (Hoover Dam) was being investigated, C. P. Squires, who was the editor of the *Las Vegas Age* for many, many years and a member of the old Colorado River Commission, suggested that there were about seventy-five thousand acres of land that could be irrigated in southern Nevada and that land would require about four acre-feet of water for each acre of land, or, three hundred thousand acre-feet of water would irrigate southern Nevada's lands. From that beginning, that figure of three hundred thousand acre-feet has become fixed as the requirement for southern Nevada. It was a central theme in the evidence presented by Nevada in the water suit—the three hundred thousand acre-feet.

It was our job to show where we could use three hundred thousand acre-feet of water. The Soil Conservation Service, the Agricultural Experiment Station, and the Colorado River Commission, all cooperated. We were able to survey, on a reconnaissance soil survey level, all the land from the Virgin River to the Colorado River south of Las Vegas. The land was classified and mapped, and every bit of evidence was presented to the Supreme Court representative, Judge Rifkind.

I don't know what influence all this work had. The judge finally said, "Nevada is entitled to three hundred thousand acre feet with some qualifications." A project is now being planned to put part of this water into the Las Vegas valley.

There are other projects which are being considered at the present time. One project would put water into the Moapa Valley. There's a huge electric plant down the Colorado River which is to use water from this three hundred thousand acre foot supply. And the Big Bend project of the state, which is carried on primarily by the Colorado River Commission is to be supplied with water from this allocation. It seems like a large supply, but when all the requirements are considered—Las Vegas with a million population or more, El Dorado Valley with I don't know how many, Boulder City, and Moapa Valley, and the Big Bend of the Colorado River and so forth--when all those demands are met the supply is, if anything, a little bit short.

Now there is a little gimmick in Rifkind's original decree and the Supreme Court's final findings that in periods of long depressed flow, Nevada and Arizona may have to cut their use of water a little bit and we won't have

quite three hundred thousand acre feet in those periods. Looking twenty to twenty-five years ahead, engineers and developers think that the Colorado is going to be deficient in two respects, one in total quantity of water, and in the quality. Because as the upper Colorado develops, there will be more return flow coming into the Colorado for the lower river to use and those waters will be higher in salts. It may become a very serious problem in the future. Now, those things are in back of this pressure to get water from some of the northwest rivers for instance, or from Alaska- -to bring it down here because people who live in southern Nevada or in Arizona, or in southern California, they're the ones that want the water and they're the ones that presumably would pay for transferring some Columbia River water to the Colorado. Well, that is a little bit of the background on the Colorado River suit. It is still going on. Arizona and Nevada won out in this suit, but that's only the first phase in any development program, to decide who has the right. Now how are you going to exercise that right?

Well, Arizona is running into some very serious difficulties in getting a bill passed to authorize its project. Nevada was fortunate. We got our bill and allotment of funds through pretty quick. It is a small amount. California would like to have four and four-tenths million acre-feet. Arizona wants two and eight-tenths million acre-feet, whereas Nevada, if it got the full allotted amount, would only be entitled to three hundred thousand acre-feet. Nevada has never been very hostile in its attitude. It's been cooperative. It's cooperated with California. It's cooperated with Arizona. It's cooperated with the upper Basin states. Its attitude has always been reasonable. It's never been starkly opposed to everything. Many people consider California to be hoggish. The state of Nevada has a small interest in the whole thing, and it's been reasonable about it. So, it got by, and it's getting by fine, so far.

The determination of water rights in the Las Vegas valley is going to be a problem because a lot of the older wells were drilled years ago and have been used for a long period of time now under old permits from the State Engineer. Permanent water rights have been acquired. I don't know how those are going to be adjusted to throw them into the overall supply which they will have when they begin to pump water to Las Vegas from the Colorado River. That is a problem which the Colorado River Commission and others in the state are going to have to face in the very near future. How are you going to recognize those old water rights and integrate them into the system? Mr. Shamberger and I have seen this problem coming up for many years, but I can't say that we have an answer.

There has been a soil survey report on both the El Dorado Valley, which was set aside for purchase by the state of Nevada, and the Las Vegas Valley. Other soil survey reports will be made later on, for the Moapa Valley, the Virgin Valley, and the intervening territory. These surveys are coming along not entirely as the result of the Colorado River water suit, but the suit has had its influence in speeding those things up. A great deal of information had to be made available during that suit and this information has been used later in the surveys that have been completed.

While I was in the Las Vegas valley, we knew that the water was going down because we kept measuring. We kept measurements of the wells that were on the margin of the artesian area from 1922 until I left in 1934. Mr. Jameson carried on those measurements after 1934. There was a constant decrease in the area of flowing water, but the area in which people lived and used water was not changed much. The pressures were constantly

being lowered on some wells. Some wells were funny; they were individualistic in their actions. We were in on the beginning of the development period. The first wells were drilled in the Las Vegas valley in about 1907; they didn't ordinarily amount to much. Some of those that were drilled just a little later were pretty good wells. We have seen some of those stop flowing entirely and the water drop down below the surface of the ground, but that usually was up on the higher lands where not many acres were under cultivation at the time. We didn't think too much about 'em.

If you went back into the Las Vegas valley today you would probably find little change in the native vegetation. In the lower part of the valley where the valley outlets toward Colorado River there has been an increase in the vegetal cover because there has been more water funneled into that territory. That was always a mesquite, salt-grass lowland, but now it has become mesquite, and salt-grass, and *swamp*! That is about the only real change that I have seen in Las Vegas area. Most of the areas that were cultivated and irrigated in Las Vegas valley are now covered with houses. Moapa Valley hasn't changed except that it has improved. Otherwise there's little in this country.

The Colorado River water litigation meant a great deal to the state of Nevada. In preparing for the suit, a review of all of the soils material in southern Nevada was made, and preliminary surveys were made of the territory from the Virgin River to and including the lands along Colorado River in the Big Bend section. Testimony was presented regarding the lands along the Virgin River, on the Mormon Mesa, in the Panaca section of the Meadow Valley Wash, the Moapa Valley, the California Wash and adjacent areas, the Las Vegas Valley, the El Dorado Valley, and the lands along the Colorado River in the Big Bend section. All of these lands were classified as to their value, possibilities for agriculture, and building either domestic or industrial types. Also, the quantities of water which might be needed to utilize these areas was calculated.

Altogether, a large amount of testimony and exhibits was presented to the court to back up the claim of Nevada for water. As it turned out in the end, the master, Mr. Simon Rifkind, apparently based his decision upon documents such as the Colorado River Compact, the related laws of Congress, and of California, and did not consider, or gave very little weight at least, to the evidence submitted by the litigants. Rifkind's decree, with minor changes, was later confirmed by the Supreme Court.

While a great mass of' evidence was presented to the court, there may be a considerable doubt that the final decision of the master was much influenced. Incidentally, the volumes of evidence presented by Arizona, California, and Nevada are on file with the Colorado River Commission in Las Vegas. The final decision apparently was based on those activities in which the United States had participated, rather than on physical evidence of the need for water as presented by Arizona, or water right filings as presented by California. A great volume of evidence regarding the early water rights in the Moapa Valley eventually proved to be of little importance because the master, and later the Supreme Court, declared that the tributaries of the main stream below Glen's Ferry were exempted from the suit. But the evidence *is valuable* because it summarizes a great many things, even though it had little influence on the trial itself.

3

The Return to Reno and Work with the Soil Conservation Service

When I returned to Reno in 1934, I had no project. All my projects had been in the southern part of the state. But Mr. Doten had some problems. One of those was the matter of the water supply in western Nevada. In those years, at the end of the long drought period, which began eighteen or so years earlier, Pyramid Lake and Walker Lake and even Lake Tahoe were at low levels. There was a considerable amount of concern expressed by people that we might continue on a downward trend and that the water supply was a very critical thing. Dr. Andrew Ellicott Douglass had been doing work with tree rings and correlating tree growth with precipitation and runoff, mostly in Arizona. Mr. Doten suggested that we might undertake some work on the Truckee River. We did study up on that and outlined a project.

Understand that all projects of the Agricultural Experiment Station, except those that are carried on by state funds alone, must be approved by the Office of Experiment Stations in Washington D.C.

This project on tree rings was approved and set up.* In the meantime, an organization known as the National Resources and later as the National Resources Council, had been set up in Washington to look into the resources in those areas which seemed to be depressed. That work was just getting underway in 1934. So, since I was kind of footloose, Director Doten steered the National Resources Committee man onto me and I was shifted over into this resources work. I was on part-time on that work for two years. And then I was shifted into the Soil Conservation Service as state coordinator.

Now, before we go into that, the amount of water required to produce vegetation, say the quantity of water that might be required to produce a pound of vegetable matter, has been under investigation for many years. By the time I was a senior student in Oregon State

*See Bulletin No. 141 (1936), "The Relationship Between Tree Growth and Stream Runoff in the Truckee River Basin. Committee"

College this was true, and there were a number of experiments underway in the United States as well as in some of the European countries on so-called duty of water, or the amount of water required to produce a crop. Usually, the problem was approached on a field level. In 1915 and '16, and later, there was in Washington an office known as the Office of Public Roads and Rural Engineering. That organization for which I worked one summer, under the rural engineering phase of the work, supplied the funds for investigation to see how much water was required for producing this or that crop under field conditions. Usually the work was laid out on a field. We would have a series of strips of land through a field of some crop, and we measured the water on and off. The difference was the amount of water that the crop used.

That was the first approach, and it was logical all right. Later the investigators began to work with tanks, putting soil into tanks and then weighing the water that went in, or in some way determining how much water was actually used by the crops growing in the tanks. That method is still in use. We have it in the Agricultural Experiment Station at the University. We have the system in many of the institutions like California and Wisconsin and Kansas. The use of tanks, or lysimeters, is pretty well standardized.

There's a good reason for these determinations because a water right is a very valuable thing, and the determination of the amount of water that is needed to produce a crop becomes economically very important. The amount of water allotted to lands in the state of Nevada is based upon some of these findings. Engineers in charge of water distribution, and the courts in determining water rights, have gone to these records for the amount of water required. The main mass of investigations are only fifty to sixty years old, yet it is an extremely important phase of irrigation and agriculture work.

E. R. "Tiny" Greenslet graduated from Oregon State College while I was a sophomore. He was involved in with Don Bark in Idaho on a series of these irrigation investigations and afterwards worked with W. L. Powers out of Corvallis, Oregon. Afterwards he became associated with the Grazing Service and was the State Director in Nevada. He is now living in Reno. I think Tiny Greenslet was working on the river near Lakeview, Oregon, in 1915, at the same time I was working in eastern Oregon.

Considerable of the work on the Experiment Station farm here in Reno was along a line of irrigation investigations on wheat and potatoes mostly and sugar beets to a minor extent. The work is continuing. It has been modified and made more scientific. The equipment at this time is sophisticated; the station has dozens of tanks where we used to have just an ordinary plot laid out in a field. But the work is still continuing. How much water is required with alfalfa growing with a water table at six feet, or four feet, or with no water table at all? It seems like there absolutely is no end to the things that can be investigated, and better results are being obtained all the time, more accurate measurements are being made. Resort is being made to weighing the water that goes into the tanks. You get a very exact measurement by this procedure.

There was a great deal of work of this kind done by the Division of Irrigation Investigations which was carried on until that division was absorbed by the Soil Conservation Service about 1940. That work is still continuing as a part of the research operations of the Soil Conservation Service,

Division of Research. And, of course, in all Experiment Stations cooperative projects are in operation.

Introducing the Idea of Soil Conservation Districts

The old county Farm Bureaus were operated by a board of directors. One of their jobs was to review the annual program of work of the county agents. Also, they approved the monthly bills of the Extension Service in the county. These two operations of the County Farm Bureau gave them a degree of control, and while that system was in effect, the Bureaus in the counties were effective. When that system was replaced, the County Farm Bureaus no longer reviewed the programs of the county agents or approved the bills of the Extension Service, and they lost control. No means of operation has as yet been devised to direct the activities of the Extension Service in the counties.

The directors of the Soil Conservation Districts have performed a somewhat similar function in the districts and can make the districts responsive to the wishes, feelings, and desires of the people in their districts.

The organization of Soil Conservation Districts was partly an outgrowth of experience of the Soil Conservation Service in its efforts to get farmers interested in soil conservation practices, such as contour plowing, strip cropping, and other practices to prevent erosion of the surface soil.

The first effort of the Soil Conservation Service was through demonstration farms and demonstration projects. The Service offered farmers money to cut out certain practices and substitute others. This entire effort was somewhat of a failure. Farmers are independent-minded. They like to do things for their own improvement and for the preservation of their properties for the future. They like to do things on their own; they don't like to be paid for doing things nor do they like to be told. They like to do things on their own initiative.

The idea of Soil Conservation Districts as a sort of an institution between the federal government and the farmer was partly the thought of M. L. Glick, who was an attorney for the Soil Conservation Service, and the Assistant Secretary of Agriculture at that time, M. L. Wilson, and probably the thinking, also, of the Chief of the Soil Conservation Service entered into the program. Anyway, Mr. Glick formulated the legislation to organize Soil Conservation Districts. During the early part of 1937, a model act for district organization was sent to the states by then-President Roosevelt.

State coordinators, of which I was one, were instructed to prepare legislation for the legislatures in 1937, many of which were meeting that year. The Act was long, somewhat involved, and complicated, but it was prepared and presented to the 1937 Nevada legislature.

The Act was passed and signed by Governor Kirman. The Act provides that there shall be a Board of Directors of five members whose duty is to act for the farmers in Soil Conservation Districts. The Directors have comparatively little power, but there are certain key activities; the main one of these is their approval of the personnel furnished to the District by the federal Soil Conservation Service. They must approve, also, the farm plans developed cooperatively by the farmer and the technician assigned to the district.

These districts offer the farmer no money for carrying out soil conservation practices. The farmer is free to carry out practices which

may be developed for his Land, or not. In fact, the practices laid down in a farm plan, or outlined in a farm plan, are cooperatively developed by the farmer (in the West we called them *ranchers*, also). Therefore, the practices that the farmer is supposed to carry out are essentially his own ideas. This effort to prevent a loss of surface soils by farmers own activities has been quite successful. The entire program for a farm involves not only some soil-saving practices, but a complete program for the operation of the farm. It includes, of course, the soil-saving practices and the application of those practices where necessary, but the crops that are grown, the locations which are to be in some permanent vegetation—trees, grass—or are even to be completely removed from any commercial use.

In Nevada, naturally, water conservation is extremely important. The first soil conservation districts were organized in southern Nevada. The Moapa Valley Soil Conservation District is district number one; the Virgin Valley Soil Conservation District is number two; the Meadow Valley Soil Conservation District is number three; Pahranagat Valley, number four. Then, since the Soil Conservation Service had a CCC camp in Smith Valley a Soil Conservation District was organized in that area and in the adjoining Mason Valley very early in the program.

As with any new organization, there were a great many different ideas advanced by the people in charge as to just what was soil conservation. Some looked upon the program as strictly the application of practices designed to keep the soil in place. And the broader aspects of soil conservation were something else.

In Nevada there was a question as to whether the application of practices designed to save water, or to make it go farther, to produce more, and so forth, were strictly soil conservation. However, many of these questions were answered by Chief Hugh Hammond Bennett through John S. Barnes, who was at that time Assistant Administrator in the Soil Conservation Service in Washington, and later became the State Soil Conservationist in California. Chief Bennett sent Mr. Barnes to a meeting in Smith Valley. Mr. Barnes gave the directors there a positive answer on many of the practices relating to irrigation. Prom that time on, soil conservation in Nevada has been moving forward with the use of water as one of the mainstays of the program.

After the organization of the Mason, Smith, and a little later, the Carson Valley districts there was quite a long pause in district organization. Then the White Pine Soil Conservation District was organized, largely through the efforts of County Agent "Mud" Townsend.

Then the Fernley Soil Conservation District was organized in western Nevada. This followed by organizational efforts in all of northern Nevada. The Northwest Elko Soil Conservation District, the Lamoille District, Star Valley District, Ruby Valley District, Paradise Valley District near Winnemucca, the Sonoma District on Humboldt River, the Stillwater District near Fallon, and later, the Lahontan District, and the Sheckler District. Districts were organized in Las Vegas valley and in Pahrump Valley.

All conservation districts have a common interest in the use of irrigation water. Therefore, those practices which are designed to improve the use of water, to make better use of the water resources at present, are always uppermost. In laying out a program for a farm to utilize water resources it is necessary not only to think of water and how you may make

it go farther and irrigate more land, but how you can pay for the necessary improvements, or facilities, for handling the water. The cropping system must be examined. Are the crops themselves the best ones? Are they the money-making crops? Are they designed to facilitate the use of the other resources, for instance, the range land? All these items must be considered in developing a farm plan.

One of the early efforts of the Soil Conservation Service, particularly the service in Nevada, was to try to find out all that was known, that had been proven, in regard to irrigation, cropping systems, crops themselves, fertilizer practices, everything that went into making a farm plan, and to get those things set down in some systematic form. This effort resulted in the development for each district in the state of a kind of a program which we called, for want to some better term, "better farming." This idea was picked up by technicians in Washington and developed into what is now called the "technical guides" for soil conservation districts.

The soils on which certain practices might be carried out vary, and the practices themselves vary. Soil surveys which accurately reflect what is necessary to be done on a particular soil are quite necessary. These form the basis for the recommendations that are made. Every district has its own set of problems, and every farm has problems, or combinations of problems, that are peculiar to that farm. These things mean that a farm plan for any individual farm must be developed for that farm and that set of circumstances. There is no such thing as a standard farm plan. This means that the effort to develop farm plans is an individual job and is very expensive. Many farms in Nevada are changing—the system of farming is changing. We're going—and have been for many years now—from the individual farm-operated type of enterprise to more of a commercial type. This is evident in many ways. For one thing, the census reports show that the number of farms is decreasing. The number of family-operated farms is decreasing. The number of large farms, the commercial type farms, is increasing. There has been little change in the actual acreage in cultivation or in use by farms in Nevada.

Many of the large farms or large ranches consist of a number of units. In developing a plan for certain of these large holdings, we have found a necessity to developing a plan for each unit. Therefore, what would appear to be one holding may actually need three, four, five, separate plans. Reporting has been a problem, of course, in all these things, but for many, many years the Washington office of the Soil Conservation Service has been most receptive and has viewed the field problem in light of what was best for the field.

Many of the administrators, including Chief Donald A. Williams, in the Washington Office of the Soil Conservation Service, are former field technicians and they have carried with them a feeling of the problems that occur in the field.

In the early days of the organization of the Soil Conservation Districts, the help of such men as John Wittwer of Las Vegas and "Mud" Townsend in Ely was very great. Later there developed, nationally, an antagonism between the county agents and its association and the Soil Conservation Service.

Still later in states like Nevada, the two services were able to get together, and did, and have worked harmoniously. For the last fifteen to twenty years, there has been a program of mutual helpfulness between the county agents and the technicians in the Soil Conservation Districts. What caused these antagonisms? Well, for many years the county agents had been the only agency or people in contact with

farmers. Very naturally, they had grown to consider themselves, the county agricultural agents or their counterparts in other states, as the representatives of the Department of Agriculture and of the Agricultural Experiment Stations and Extension Service in the field. The subject of soil erosion or soil conservation had been pretty much overlooked, or the effects of conservation or lack of conservation, the effects of soil erosion were not fully recognized. Not until after the Soil Erosion Service came into being, and the effects of the lack of conservation become well-known to the people generally. Then they began to become aware of the effects of soil erosion.

The Soil Conservation Service entered into the field with soil erosion as its basic principle of operation and advocated many things which county agents were not really ready to accept. Generally, the feeling among the agents was that the federal government was entering into a field which county agents and their organization were supposed to handle.

In many locations, the Extension Service as a whole refused to go along with the federal Soil Conservation Service in some of the practices they were advocating. There was a feeling that the entire program of soil conservation should have been given to the state institutions, for instance, the Extension Service, and that there should have been no federal organization in the field.

The differences of opinions led to some very bitter fights at the Washington level. A number of attempts were made to eliminate the federal Soil Conservation Service and to turn over the entire operation to the Extension Service. Only the feeling on the part of the administration in Washington, including the President, that this was an extremely vital program and to get started it must have some freedom of action, therefore a new program, helped. Those are some of the reasons for the antagonism, or lack of cooperation, or whatever you might call it, between the Extension Service and the Soil Conservation Service.

Since our operations in this state are on a comparatively small scale, we felt this conflict most acutely. But we gradually came out of the period of conflict, and good relations were developed with the Extension Service, and, at the present time, relations between the county agents and technicians of the Soil Conservation Service in the various districts in the state is on a high level. The county agents are learning how to utilize the Districts and to use its services to accomplish their aims. We're all in the same program. No one can afford to neglect to utilize what services are offered. The number of things to be done is so great that we can't let our own personal feelings interfere with carrying out what needs to be done. Among the agencies with which the Soil Conservation District had to deal was and is the Grazing Service, now the Bureau of Land Management.

A range land which involves grazing must include a complete program to be carried out on a ranch. This means those lands that are owned by the farmer, or rancher, and land under the control of the Forest Service, or land under the control of the Grazing Service. Developing a plan which includes all these interests, the farmer, the rancher, the Forest Service, the Bureau of Land Management, perhaps even the Indian Service comes into this, is a complicated things. All the agencies, as well as the farmer, must agree that the practices outlined in the farm-plan or ranch plan are the right ones. To bring about a complete understanding has been one of the efforts of the Soil Conservation Service and of the District Associations. To

speed this up, a program known as the "pilot district program" was developed, in which a soil conservation district in each state has been selected as the demonstration district or pilot district. In Nevada, the Northeast Elko District was chosen as the "pilot district."

The idea in this was that a special effort would be made to develop farm-plans for every individual ownership in that area. Most of the lands, outside of the private lands, are under the management of the Bureau of Land Management. It is a comparatively small district, about two million acres, and about twenty-one to twenty-two, farms, or ranches.

Before a complete ranch plan, including range plan, can be developed for these holdings, the land which would be assigned to the individual rancher by the federal agency, in this case the Bureau of Land Management, must be defined; therefore, private allotments must be made. You can readily see that a ranch plan involving private lands and the public grazing lands must be made for a specific unit of land. Therefore, the breaking up or allotting to these individual farms of the areas of grazing land must be made complete before a range plan can be developed.

The allotment of public lands to private owners is outlined in the Taylor Grazing Act, but the practical determination of each parcel of land is a rather difficult task. The Grazing Service, later the Bureau of Land Management, has worked on this problem for years since the Taylor Grazing Act was passed, and the job of making these allotments to private owners is *well along* in Nevada.

Thinking a little bit about the possibilities for conservation, it has long been my feeling that if we're going in the right direction, time doesn't make too much difference. If the rancher is making an income sufficient to maintain himself, in the best condition that can be developed, whether we do those things in the lifetime of an individual or several generations doesn't make much difference. It's going in the right direction. If it's going in the wrong direction—oh, well, then there's no hope. If, once the things that are necessary for improvement are established and are being put into effect , the number of people available to carry out these things and the amount of money that can be made available to do the things determine the speed with which you can carry these things out. But it doesn't make too much difference if we're going in the right direction.

Now, in the Soil Conservation District, and in the Grazing District, and in the Forest Service areas, and in the Indian Service lands, in all of those, the ideas for improving the private lands, and the range lands are moving ahead. As a whole, the destruction of our cultivated land resources has been either arrested or completely eliminated. We are, as a whole, becoming extremely aware of unnecessary wastage. There are a great many indications that soil conservation is accepted now as a necessary thing. That being the case, then the carrying out of these things can take place will be done as people are willing and able.

In developing farm and ranch plans, we have found that there are separations necessary between farmers. Farmer "A" is making a go of his place- -he's making a little money. We find out in a community there's always farmers that are able to do things, and we spend more time with them. The soil conservation districts supervisors generally direct their attention to this fellow as against that one. Farmer "B" is able, but he hasn't been too well convinced that he ought to do anything, and he's indifferent. So, leave him alone for a little while. Farmer "C" may be everything that you look for, but he isn't able for one reason or another—lack of facilities or

money. There's no use spending a lot of time trying to work with Farmer "C."

In our earlier efforts, I think a good deal of time was wasted in trying to get conservation activities with Farmer "C's" efforts. As I said earlier in the story, the farmer is the one who finally determines whether a thing is going to be done, and that is true whether he is on a crop farm in western Nevada, or on a big ranch in eastern Nevada. The individual must carry out these practices. Well, why work with Farmer "B" or Farmer "C" too much? Farmer "A" is ready, willing, and able. He's the one that will *do* things.

Now, in a territory such, for instance, as Northeast Elko, not every one of those twenty-odd farms or ranches is able to carry out at once all the practices laid out, but they're all doing everything that they can do. That district, I think, as a pilot district has been quite successful.

A practice designed, say, to improve the condition of the Grazing Districts ranges, must be one that Soil Conservation Service and Soil Conservation District have approved, and one that is practical. Therefore, there have been long delays in carrying out some programs which seem to be, on the face of them, good ones. Every step must be cooperatively determined to be the proper one.

Now, if we can put the range lands into the proper use by the right livestock and use these ranges at the right season of the year, and take from them only the amount of annual growth (and that, of course, varies from year to year) then we can say that range is being properly used.

How can you accomplish that? Well, there have been plenty of arguments as to how that can be done, but there are certain things that are becoming more apparent all the time. There is a conflict between cattle and sheep. Sheep can be herded, hence, no fences are necessary between units and areas. Cattle are individualistic—they wander over a territory—so fences are necessary. They cost money. You fence an area and you say you are going to use it in a certain time of the year; then there must be water within that area, which means fences *and* water development. Throughout Nevada cattle require salt. Where would you locate salt? Close to the water? Away from the water, or some other place?

On the range land there is competition between plants. Some of the native plants seem to thrive under certain conditions of grazing. How to discourage the bad plants and encourage the ones that you want to encourage is a big question, and not every technician of the managing services is willing to say that there is a practice or combination of practices that must be carried out or should be carried out to accomplish the desired result.

I would say that, as a rule, the practices needed for most of the lands in the state of Nevada have been pretty well agreed upon. Now, how to accomplish those things, and the time in which to accomplish them, is something else again. How can we figure how many miles of fences we will be able to build within a period of time to get this block of territory under complete control? How many wells and watering holes can we develop? The Bureau of Land Management, the Forest Service, and other agencies are moving along on these things very fast considering the resources that they have available. The direction of the movement is right. That's the thing that, to me, seems the most important, it is going in the right direction now.

An individual who operates on the range can be slow about carrying out practices, or he can move ahead very rapidly, as fast as his resources will let him move. In some places

we see very rapid movement and other places comparatively slow movement. People are not able, and the resources of the Bureau of Land Management, for instance, are not sufficient to put in all the fences that are needed and they're not able to take out all the brush that ought to be taken out.

Many of the areas of Nevada now are pretty largely taken over with sagebrush. From our own observations and from reading the reports of earlier times, we get an impression that many of these areas were once grass land. How to restore the original condition is, of course, a problem for which the range user and the range manager faces and must attempt to find some solution.

Thousands of acres of sagebrush have been plowed and reseeded to crested wheat.

This particular grass has been used because it is adapted to arid conditions, dry-land conditions, and will produce a crop where the average rainfall is around eight inches and because it has a large, viable seed. Some of the native grasses of the same family as crested wheat do not produce viable seed every year, and the problem of finding a variety, or strain, which will produce seed has occupied technicians in the Experiment Stations and the Soil Conservation Service for many years.

The costs of plowing up a stand of sagebrush and reseeding with an improved grass are pretty high. There've been many questions of whether the returns of reseeded land over a period of twenty years or so would pay for the operation. This question has been investigated by economists of the Soil Conservation Service, the Extension Service, and the Experiment Stations in the state. It is, however, a very complicated thing. As indicated earlier, to get proper use by such animals as beef cattle means fencing, water development, salting, and proper seasonal use. When you have developed fences, waterholes or watering places, proper salting, and have the range under such control and you get the best seasonal use that you can get, there are many side effects which influence cost and management. For instance, you don't have to ride very much if your cattle are fenced in. More forage means generally higher production, more pounds of beef to sell, the death losses are less, the livestock make better utilization of the ranch forages. All these minor things must be considered by the economist in attempting to show whether major operations like fencing and brush-removal and reseeding are effective and economically justified.

Among the practices, or series of practices, that determine the best season of use is the one that soil conservationists for years called *deferred rotation grazing*. Plants require a period of growth and the storage of some part of their production of plant food down in their roots and in the lower parts of their stems. If plants are grazed continuously during the period of growth, they lose vigor and die out, and plants that are not so palatable to livestock take their place. We have seen this process going on. On the range lands, some of the shrubs—white sage, for instance, is quite palatable. If it is allowed to. grow and then is removed in the winter season when growth stops, the white sage will thrive and produce maximum returns. If grazed during the season when the plant is making maximum growth, it loses vigor, dies out and is replaced by other plants, principally, on the ranges in Nevada, by the small rabbit brush. This plant has very little value. Indian rice grass has growth habits quite similar to white sage. It can be eliminated, and has been eliminated in many areas, by heavy grazing during the growth period. Where it is allowed to grow and is then removed by grazing during the

wintertime, the dormant period, it retains its vigor and the stands are good.

All the operations which will permit the best use of some of these fragile types of vegetation on the desert ranges of Nevada must be done at low costs because the territory is not highly productive, rainfall is very low, and large areas must be grazed to give any return. Progress under such conditions must be slow. Considering all of these things, the progress made by the Bureau of Land Management probably is as good as could be expected.

These things are of interest to the directors of many Soil Conservation Districts because the ranchers in these districts must depend upon the areas of grazing lands for a substantial part of their income. There is therefore, a direct line of interest between the conservation districts and the land-managing agencies.

Along with improvements on the grazing lands must go a series of practices on the private, irrigated land. Throughout most of Nevada, in the development of improved production from the irrigated land and higher production on the grazing land must go hand in hand. The Taylor Grazing Act itself requires such a mutual or commensurate type of production.

The Development of a Farm: Plan for the Petan Ranch

A farm-plan is a program for the operation of a ranch or farm. Generally it starts with a map of the soils of the farm or ranch. The farm-plan is outlined on the soils map. It is a complex procedure. The farm-planner must recognize the inherent productivity of the various soils on the farm, and be able to work with the rancher or farmer in developing a program which will make the best use of the water supplies and produce the most crops, and those crops that can be utilized by livestock or can be sold at a profit.

In developing a plan for a farm, we usually start with the irrigation system. How should the water supply be utilized? What system of irrigation should be used on each type of soil? Each slope? This phase of farm-planning is extremely difficult and involves an intimate knowledge of how water behaves on various soils, slopes, and with the crops grown. After an irrigation system has been laid out and the main ditches with all of the facilities for controlling water located and described, then the problem of determining what crops are to be grown, what rotation system is to be utilized, and what fertilizers and or soil amendments are to be applied, remain for the farm planner and the farmer or rancher to determine.

The broad principles involved in making a farm-plan, that is, the types of irrigation, the approved crops that may be grown, and a general outline of the soils that are usually found, is developed for each Soil Conservation District. This information then forms the basis for the judgment of the farm planner and the farmer or rancher. The technical guide, or general guide, is for the development of a farm under the normal conditions encountered in an area. But each farm has its own peculiar set of circumstances and problems which must be considered in the development of a farm or ranch plan. The farm-planner has the assistance not only of the technical guides but of technicians in each individual line of work such as irrigation, field crops, livestock, range management, and so forth. Generally, the soil conservation districts have developed plans for control of erosion and the economical production of crops. They do not consider or work particularly with farm buildings, class of livestock, and so forth, which factors all have

an influence on economic returns, but these factors generally are felt to be in the fields of other agencies.

As an example of the development of the farm plan, we will make reference to a plan developed for the Petan Ranch on the Owyhee River. Mr. C. H. Jackson, the owner of this property, bought the holdings of the Garrat brothers, which holdings included a large area of meadow land, livestock, principally beef cattle, and range lands. This is a very large individual setup, and at one time ran eighteen to twenty thousand head of beef cattle. The rivers, mainly the Bull Run branch of the South Fork of Owyhee River, the main South Fork of Owyhee River, and other small streams, ran erratic courses through the meadow lands. The river banks were lined with willows, and the meadow areas were in various shapes and sizes.

Mr. Jackson indicated a desire to improve the production and the appearance of these meadow lands. This involved the removal of the streams from the bottom land and placing of them along the edge of the bottoms. Since the gradients of the streams were greater than they should be, there was a necessity for developing grade-control structures in the new channels. Even with the grade-control structures installed, there was considerable erosion of these channels. To correct this condition, Mr. Jackson inaugurated riprapping with large blocks of stone. All of the streams in this area have heavy runoff in the springtime and low flow in the summertime. To equalize the discharge of these streams, Mr. Jackson has built three rather large reservoirs. These not only equalize the flow of water, but act to cut down the size of the spring floods.

The change of the cropping on the meadow lands involved a very difficult program. First the stand of native grasses must be destroyed so that the land could be leveled. Then the land must be leveled so that even distribution of the irrigation water would be possible. These lands must be seeded with approved or adapted grasses and clovers and alfalfa. Finally the fertilization to make yields as high as feasible must be determined and carried out.

In the program for this particular property, the farm plan has been amended a number of times. The Garrat brothers had put together a very large holding. Mr. Jackson has added to this holding by the purchase of adjacent properties as the owners retired or for some reason desired to dispose of their properties. So far as is know, every purchase by Mr. Jackson has been at the insistence of the original owners. This development is illustrative of the things that must be done before a ranch property can be operated under improved or new conditions. A very large area of range land has been operated in connection with the ranch operations. The outline of the range operations and how they are to be carried on is another part of the complete ranch plan.

In the Soil Conservation District movement, the central theme has been control by the local people. For instance, Mr. Jackson, on his farm, has certain ideas of how things should be run. Technicians assigned to assist Mr. Jackson can assist, and have assisted, in certain technical phases of operations. But they do not control the individual or the groups of people. Mr. Jackson feels that in his operations the coyote is a beneficial inhabitant and he encourages them. He feels that the coyote keeps down the rodents and doesn't bother his livestock. Other people have different ideas. For instance, in the Lamoille area the coyote has been hunted and poisoned and has been replaced to considerable extent by the bobcat. Now which is the better predator for an area, I don't know, but the

bobcat is plentiful in the Lamoille Valley and the coyote is prevalent on the Petan Ranch.

These developments are merely illustrative of the control exercised in soil conservation districts either by individuals or by groups of people. Technicians can assist, but they cannot change the character of an area or control the wishes of the farm or ranch operators. In many of the range areas it would be possible to effect control of rabbits and other of the rodent population by hawks. The hawk likes to perch on a barren tree or some elevation where he can survey a surrounding area. Unfortunately, the hawk makes a very good target for the amateur hunter, so in any effort on the part of the rancher to improve the habitat for hawks by erecting perches, he must locate them far enough away from the roads for the hawk to be out of the range of the average hunter. Perches are a very simple matter to make- -something like a telephone with a crossbar near the top. Experience was indicated that any perch erected for a hawk will be occupied within a short time.

The assistance of biologists in working out the methods and means of predator control is part of the Soil Conservation District program. Other phases of biology, such as those kinds of things that will encourage deer or fish, can be part also of any district's operation. The Soil Conservation Districts are working very closely with the State Fish and Game Commission in an effort to improve the ranges for both livestock and deer. This is a subject that has been a matter of controversy for many, many years. Many ranch operators feel that the deer compete directly with domestic livestock for feed, and in some circumstances this seems to be true. The deer come down into the summer range and apparently compete with livestock. In the wintertime the deer feed on bitter brush and sagebrush in areas where livestock do not feed, or feed to a very limited extent. Ranchers usually are very good conservationists. They support the efforts of the Fish and Game Commission to improve hunting and fishing, and, to some degree at least, they benefit financially from improved hunting and fishing. I think it would be quite out of line here to try to discuss the entire field of game conservation, of hunting and fishing; I think that is something that could be better discussed by the, game conservation people.

The development of the Petan Ranch is illustrative, or indicative, of the type of development which might be done on Humboldt River. At the present time, the area of Humboldt River above the Rye Patch Reservoir is largely devoted to the production of native grasses on lands that are irrigated by the spring runoff of the river. At the present time, there are very few possibilities for changing the types of grasses, clovers, and sedges produced on these meadows. If they are to be changed to any other type of production, the first necessity would be to control the run-off of the river so that excessive flooding would be prevented and a more even flow of water would be secured. The developments, at present, are limited to border or edge areas of the meadows which are not subject to overflow, or areas within the meadows where more complete control of water can be accomplished.

The three dams proposed by the Corps of Engineers of the U.S. Army would have a major effect upon the distribution of the run-off and would largely control floods except in exceptional years. This would make possible the change of the meadows in many areas to other types of vegetation. Experience could possibly indicate that other reservoirs on the river would be necessary before complete control could be accomplished. The complete change of the type of production, irrigation,

and cropping, would be very expensive and would take a number of years. The bottom lands would need to be surveyed and mapped by soil surveyors as a basis for recommendations for different kinds of crops. In additions to the reservoirs, there would be needed more canals with structures so that the water supply could be placed under complete control. Meadow lands along the river appear to be level; however, they are not level to the extent that even distribution of water can be effected. Land leveling would be necessary, therefore, on most of the meadow lands.

I don't know of any changes that might be made along the river under improved irrigation, improved control of the water, improved cropping that would have more than a minor effect upon most of the wildlife. If more grain and cultivated crops were introduced, some bird species might be encouraged, such as Chinese pheasants, or quail. I don't think one could expect very much change in the fish life.

The Jackson ranch as an example, has developed storage reservoirs, has moved the channels out of the meadows and straightened the channels of the rivers and creeks, has stabilized the grade by grade-stabilization structure, and has riprapped many of the areas of the channel where erosion was taking place. If the Humboldt River area were to be placed under complete control with new crops, I think we could anticipate that many of the practices that have been found necessary on the Petan Ranch would have to be applied to the Humboldt River area. As indicated above, this would involve the storage of water in not only the three main reservoirs now proposed, but additional ones. Many additional structures along the river, many canals, and the rejuvenation, or change, of crops on the meadow lands. To make all of these things economically feasible, there would be needed many changes on the companionate range lands. The areas that are suitable would need to be reseeded; areas of reasonably good native grass stands would need to be encouraged by the control of the sagebrush through spraying. Proper use of the entire range area would require fencing, waterhole or water developments, salting, and other range practices that might be found to be necessary. If all of the things that could be done, *were* done, the production of the Humboldt River area would be appreciably increased over the present production.

Indicative of some of the difficulties that we may encounter in changing the range lands, I recall that in the early 'forties when districts were being organized in Elko County, some of our range technicians were advocating the reseeding of some of the better lands which had been completely taken over by sagebrush. Many attempts have been made to change or reseed some of these lands, but many of the efforts were made on a small scale, and any small scale work on range lands runs into difficulties. Predators, which include rats and rabbits, and sometimes livestock, tend to concentrate on improved areas. Very small areas are very often eaten out and fail to show what might be done. The Soil Conservation Service and the Soil Conservation Districts, advocated the reseeding of comparably large areas, at least several hundred acres in extent. Ranchers did reseed many areas, and their experience indicated that reseeding could be done successfully. On areas receiving as little as eight inches of moisture, the Bureau of Land Management has reseeded many large areas with good results. At the present time, reseeding is accepted as a normal practice. The entire area has many hundreds of thousands of acres of reseedable land which once was good grass land and now grows only sagebrush and cheat grass. The development

of the Humboldt River area would include the improvement, either by reseeding, or by some means of discouraging the sagebrush and encouraging the grass, on every acre capable of such improvement. Probably, the demands for food in the future will be sufficient to force the complete utilization of all of our resources, both irrigated lands and the companionate range lands.

On Humboldt River above Lovelock, the winters are reasonably severe and necessitate the hand-feeding of livestock. The summers are brief. Frosts come late in the spring and early in the fall. The crops that may be grown are, therefore, limited. Production is pretty nearly limited to forage crops which can be utilized by range livestock. The development of the entire area of the Humboldt River is therefore, one of improving the production on the meadow lands, or irrigated lands, and the improvement of the production on the companionate range lands.

One of the effects in recent years in the ranch area of the application of conservation practices is an increase in production of ranch forage for livestock. This, in turn, has an effect on the range lands which encourages such practices as reseeding, water development, fencing, salting, and the practice of deferred rotation grazing. In other words, an increase in production on the irrigated ranch land encourages a commensurate increase in production on the companionate range lands. Or, if the increased production comes on the range lands first, which often happens, this encourages the increase in production on irrigated land. This influence, either from the range or the irrigated lands, has been operating for a number of years throughout the state of Nevada.

About eighty-six percent of the total land area in the state is controlled by federal agencies. The main land agencies are the Bureau of Land Management, the Forest Service, the Bureau of Indian Affairs, and the federal Wildlife Service. The effort on the part of ranchers to develop a year-round operation very soon required the cooperation of one or more of these federal agencies. Generally speaking, the Forest Service, since it has been in operation for many years, has a grazing program established for the land which it controls. The operations of ranchers, and Soil Conservation Districts' therefore, in the beginning of the efforts to develop a cooperative ranch were mostly concerned with efforts to work with the Bureau of Land Management. Before this agency is in a position to work with the rancher on a year-long grazing program, it must first establish a permanent allotment of land to the individual ranch. Once a permanent allotment has been made, the Bureau of Land Management is in position to cooperate in the development of a ranch plan. The effort to establish individual allotments has been going on now for about twenty-five years in the state, and in many areas allotments have been made which include practically all the lands within these areas.

There is reason to feel that within the next twenty years most of the territory within the state will be allotted and will be covered by plans developed cooperatively with the rancher and the Bureau of Land Management. Or, where another agency has an interest, with that agency.

Occasionally, the individual private owner develops a range plan with the Indian Service, and, particularly within the northern part of Washoe County, with the Fish and Wildlife Service. In many of the agreements which involve game reserves, the grazing programs of the individual ranchers are worked out with the state Fish and Game Commission officials.

Experience has indicated that some areas, such as those in northern Nevada that are utilized mostly by antelope, benefit from grazing under controlled conditions by domestic livestock. The game animals like browse, and the domestic livestock like grass. The great problem has been to secure the degree of grazing by domestic animals which gains the most benefit to the range lands and consequently to the game animals. With improved conditions such as more fences, more watering places, and a more widespread knowledge of the needs of the game animals and the domestic livestock, and the effects of grazing by both classes of animals upon the vegetative cover of the land, we can expect more grazing by domestic livestock and improved ranges for game animals.

One of the great problems in putting into effect all the knowledge that administrators have is purely economical. How much money can an agency afford to put into the expensive improvements? Fencing, water development, moving of livestock from one pasture to another to fit a program of seasonal use, all are expensive operations, and generally speaking, money has not been provided from any source for such operations.

There is reason to believe that as people, those directly concerned and those in the general public who are indirectly concerned with such operations, will see the need for money and will insist that the funds necessary to carry out these operations are provided. The costs are pretty high. The best that can be done in reseeding involves a number of operations such as plowing, procuring and planting the seed, and deferment of grazing while the new grass is becoming established, and then fencing or some control of the livestock to utilize the grass in the proper season. All these are expensive operations.

However, some of the unusual equipment required for these operations, such as that employed in plowing and drilling operations, has been provided. In many cases, specific types of equipment had to be developed for the job to be done. As I say, many of these things have been provided so that the cost of some of these operations has been reduced in recent years.

If an analysis which took into account all the factors, such as increased productivity, improved condition of livestock, reductions of death losses, reduction of the cost of management, and other minor items was made, the chances seem to be good that a program such as contemplated in a complete ranch plan would pay. The rancher would need be assured of twenty years in which to recover all costs.

What might be required in the way of amendments to the Taylor Grazing Act itself to assure such continued operation is a bit difficult to say; however, amendments have been made, both to the Act itself and in the regulations of the agency.

The Effects of Recent Inflated Land Prices

The effects on the economic setup of the state of the sale of large ranches to outside economic interests is a little hard to assess and understand at the present moment. One of the effects has been to greatly disturb the old rule-of-thumb standards for assessing the value of ranch property. In all of northern and eastern Nevada, there is a necessity for about tour months of hand-feeding of cattle. An acre of irrigated land, under the old system of management, would take care of about one animal unit, that is, a cow and calf, through the four months of the feeding period. The value of a piece of range property then could

be rated by the number of cattle that could be supported during the winter period. There are other factors, of course, such as the quantity in acres and the quality of the open range lands.

Recently, that is within the last ten to twelve years, ranches on which irrigated lands were situated have been sold with apparently no regard for the number of livestock that could be supported during the winter period. No one at the present time apparently has any very good idea of what this development may eventually lead to. Along with the change in the basis for appraising ranch property, has come conservation practices such as land leveling, ditch revisions, irrigation structures or facilities for distributing water, and water storage, and some changes in cropping systems. The final effect of all these practices is hard to analyze. But generally, the ranchers who apply these practices and the technicians who encourage such practices feel that they will pay for themselves within a reasonable length of time, say, within twenty years. Maybe the high prices that people are paying presently for these ranches might not be out of order if you consider the long run. Some of the high prices seem to be motivated by a desire to dodge federal income tax. What those prices may mean eventually, I don't know. Some part of the higher prices can be justified on the basis of the general increase in the cost of living- -say a three to three-and-a-half percent per year increase. Some of the prices just seem to have no firm connection with anything in past history.

When someone buys a ranch in the middle of an area and pays a price for this property away out of line with respect to the valuations of all the ranches around there, assessed valuation are affected. Does that build up assessed valuation, or does it depress the value of lands of other owners around there? I don't know. Ultimately, ranch land must be assessed on some reasonable basis, generally speaking, upon its ability to produce. For instance, a portion of a large ranch in eastern Elko County was subdivided and sold in small lots of forty acres and up, at an inflated price per acre. It was assessed on the basis of the selling price. A few years later, Elko County found it had to write off millions of dollars of assessed valuations because many of these properties couldn't produce anything, and those who had purchased simply quit paying.

Some ranch properties are purchased for investments and with the anticipation of recovering at some future time. In the meantime, those properties may not pay all the current expenses.

A governmental agency, such as a county, can't possibly foresee what property might be used for in the future. Therefore, it can assess only on the general income-producing power of all properties of a similar nature. Hence, to get back to the question, the purchase at what appears to be a high price in the community of an individual piece of property may have very little to do with the assessed value of other properties. The assessment of individual property in the county is in accord with certain broad rules developed for the guidance of the assessor. But property can be assessed only in accordance with the information available. It's entirely possible that the effect of purchase at an inflated price of individual properties may be completely disregarded by the assessor. Now, there are other cases in which, say the water supply is not well-known for some reason or another—it hasn't been carefully mapped or anything of the kind and the assessor may completely overlook this. He has hundreds of properties to assess and he may completely overlook one, and he has no basis for judging whether or not, if that property were sold, whether

the price was in line or reasonable with its producing power. These are all problems.

The general rule of the state, that property must be assessed at about thirty-five percent of its market value has had a marked influence on assessed values. Well, we might go along with the assessor and the state board of equalization, but we couldn't help but have some feelings for those property owners in Virginia City whose assessments were increased recently. Thirty years or a little better than that ago, Virginia City was a kind of a forgotten community. It was approaching ghost town status. It had no values, and properties were just simply worthless lands and buildings. Highways and increased tourist business and the location of people who either had an income, or could develop one, have changed that situation in Virginia City. Now, should the assessor say, "All right, at the present, values are such and such," because those values are judged by comparatively recent sales, and you can assess from the basis of those recent sales?

To get back to the effect, economically, on the state, of artificial values or inflated values of farm property, I'm not so sure. One of the effects of purchases of farms by outside monies has been the acceleration of the tendency to consolidate and make bigger ranches. That tendency has been very strong in certain areas in Nevada but whether it is good or bad, depends upon the viewpoint of the individual, I presume. But, the tendency to group properties into larger holdings is nationwide. We have better equipment for ranching and farming. We have better communications. Highways are better. Telephones are better. And in more isolated areas, we're successfully communicating by wireless. That means the individual operator, in many cases this is the foreman, can oversee and manage more territory.

Occasionally, we see ranches expanded beyond the ability of the average guy to manage. Such expanded operations very often fall apart when the man who put them together passes on or quits operation.

I would anticipate that there will be some continuation of the tendency to build larger ranch units, or farm units, because economic pressures will operate to bring this about. It is no longer easy to get farm labor. The old time farm laborer is no longer available, and the new farm laborer doesn't like to travel like the old one did. Therefore, it's become more economically feasible for the individual farmer or rancher to own equipment. Equipment replaces the farm laborer, and the owner of equipment can schedule payments or depreciation over a period of time. Also, he gets some credit for those things in his income taxes. One individual is able to handle more acres of land or more units of crop than could be handled by such an individual under other conditions. There is also the matter of dependability. A piece of equipment with repairs and parts and replacements reasonably available, which is now possible for almost any location in the state, becomes rather dependable labor. Human labor is less dependable.

As a nation, along with a good part of the world, we are users of sources of energy which were not commonly available even fifty years ago. These include the gasoline motor, the diesel motor, and electric power. On the ranch, they're comparatively recent newcomers. Some of the calculations that were made twenty years ago on the use of electricity under rural electrification programs looked to such things as were normal in a household in a city or an urban situation (those involved lights; a little heat, perhaps; maybe some cooking, not much; ironing and so forth, but as much as would

be used in a household). But, the experience of rural systems is that the use of electricity on the farm was two to three times as great as calculated in the beginning. Such things, for instance, as electric sickle grinders, electric feed grinders, and many applications that weren't common in cities and, hence, weren't taken into account, occurred on the farm. Those things all mean that the *time* of the farm family, the manager, and his help is expanded greatly. He can handle more territory, he can handle more operations than he ever could before.

A piece of equipment, for instance, a mowing machine, breaks down. The operator is able to phone in to the nearest supply, get in his car, and in an hour or so's time, he has picked up the repair parts and in no time he's back to the ranch. In, say two to four hours of elapsed time, the equipment can be back in operation. Now in earlier times, there was no phone, the forty- or fifty- mile trip to town took anywhere from a half a day or longer and then the chances were the equipment dealer had to phone someplace else for parts, and another twelve to twenty-four hours delay was encountered. Then another trip back out to the farm. So, instead of, say four or five hours, you had as many days. In the meantime, maybe all operations had stopped. Those are some of the influences that are common throughout the state, on the range and ranch lands.

Some of those things have made possible the improvement in conservation practices applications that wouldn't have been possible forty or fifty years ago. Most of the improvements that have taken place on the farms and ranches of the state are less than one hundred years old. Most of the improvements, most the inventions that have come along, came after about 1860. The binder and reaper, and the gasoline motor that made possible such things as tractors, push-mowers, and other machines came after 1860. There has been a change in motor power. The first gasoline tractors were not so good. They could be used under certain circumstances, but they weren't generally suitable under variable conditions. Now any rancher has a wide choice of tractors that are all good for their intended purpose. They're made for certain purposes and they fit those conditions. Trucks, such as the quarter-ton, half-ton, three-quarter-ton pickups, are available to any rancher that wants to pay money for them.

A pickup and a trailer provide the transportation for one or two horses. A rancher can load a pair of horses into a trailer, drive one hundred miles out to his range land, put in eight hours or ten hours of riding, load the trailer back up and he's home in one day. Such an operation would have taken the better part of a week in an earlier time.

And these things are being done all the time. It makes possible for a large unit to become an economic entity. A big outfit becomes an operating unit. How this may affect such things as the 160-acre limitation is another matter.

Those economic factors, however, have an effect upon application of conservation measures. The very small units simply can't afford to put some of the conservation practices into effect. On forty acres, for instance, if you increase the yield of alfalfa from four tons to eight tons per acre, that means tremendous things on an acre of ground—double the yield- -but the return for a man who has only forty acres is not very great. He just simply doesn't have enough acres to make a return. So he might be, and often is, compelled to continue operations on the low per-acre yield, rather than to improve conditions and get the full potential of the land. This influences operation both

on a ranch property, which depends upon production of its own irrigated land and the land that are controlled by other agencies and on the small ranch controlled entirely by an individual.

Eventually the force of economic conditions will impel the development of larger units of land. We have seen, and we will probably continue to see, an increase in the size of the unit and a decrease in the number of individually owned and operated ranches or farms.

Resolution of Conflicts Between SCS and Other Agencies

There has always been some degree of conflict and differences in the objectives of the Soil Conservation Service and of other agencies. This has been indicated to a degree in the previous discussion of the effort to develop a range plan which involved the cooperation of the Bureau of Land Management. The Soil Conservation Service grew up around the idea of the prevention of erosion and the loss of farm land, and gradually developed the idea of increased production and at the sane tine the preservation of the body of the soil. The work of the Soil Conservation Service, in its earlier years, was very largely with the individual ranch or farm owner.

In many cases, the efforts of the ranch operators to secure the maximum returns have led to the destruction of the basic resource. On the range land this may have meant the elimination of the native forage plants and the increase of introduced vegetation or plants, or the lighter growth of some native plants. In any case, these operations led also to a loss of the surface soil as well as the loss of the plants that were economically valuable.

The Soil Conservation Service, in developing a farm-plan or ranch plan, must encourage a rancher to carry out certain practices. Sometimes those practices were not approved entirely by the public land-administering agencies and other agencies. Either the administering agency could not agree that those practices were needed or economically valuable, or there may have been some legal reason in the custodianship of the land that prevented the agency from carrying out some practices. Conditions have created areas of disagreement. Occasionally, the federal laws have described the areas of jurisdiction for certain agencies.

Descriptions of agency functions were not always specific. Sometimes they allowed for interpretation by the agency; therefore, there have been conflicts on interpretation. Twenty to thirty years ago there was a great deal of argument about definitions. How could you define the basic function of an agency like the Soil Conservation Service? Well many people would say, "soil conservation means saving the soil," but the program of the soil conservation as it developed was considerably broader. It meant conserving the soil, keeping the body of the soil, but making it fully *productive*. Many agencies have the job of saying what would be the best use of the land, the treatment that would make it most productive. So there've been points of conflict, points at which the programs of different agencies kind of met. How much fertilizer you should use, and when, and how, and what, and all that kind of stuff. Who should tell the farmer what is best for that piece of ground, the Soil Conservation Service man out in the field, or the county agent? Or, in some cases, recommendations for fertilizer were being made for land that was controlled by the Forest Service, or the Bureau of Land Management, or some other agency. Maybe the fertilizer needs might be recognized, but how much? Just exactly when should it be

applied, and so on and so forth? Those are all questions that have to be worked out, and you come to sort of an agreement that the use will be such-and-such, and the material will be described in some way or other, so that it's possible, then, to say to a rancher, "*Yes*, this practice is feasible and desirable and returns can be expected."

It's very natural that that the administrator, being human, may react unfavorably to a new suggestion that comes entirely from outside his normal operations. We do that. Everyone does that. The Soil Conservation District and the officials from the district have been of great assistance because those were groups of people who were not employed by the federal government, or the state government, and that could make suggestions that other people couldn't make. They, of course, first had to be convinced that a thing was right.

Well, from a larger viewpoint, there has always been a conflict and always will be a conflict between agencies. There are purely federal agencies and there are combinations of federal and state agencies that come into conflict. The Corps of Engineers and the Bureau of Land Management, both federal agencies come into conflict in some projects. I would, I think, say that the recreational interests represented generally by the fish and game people in each state and by some recreational groups, such as the Sierra Club, and so on, have been most active in many reclamation projects and projects of the Corps of Engineers. The interests of the recreationists, represented by the technicians of the state commissions, in regard to preservation of fisheries and fishing areas and hunting areas, have been uppermost.

Over the years, many of those conflicts have either been resolved or the viewpoints of the various interests have been become recognized. For instance, the interest of the recreationists have been recognized to quite a degree in every reclamation project, both by the Bureau of Reclamation, the Army Engineers, and by the state. I don't know, at the present moment, outside of the battle for money, that any of the basic conflicts are so very great. It seems to me that there is a tendency for each of the agencies, Soil Conservation Service for one, to recognize that the other agencies have a place in the field in which to work; therefore, the tendency is to recognize the other fellow. There is no problem at all any more, in sitting down with the Bureau of Land Management to discuss common problems. No problem at all, no stress at all, in sitting down with the county agents or the state extension service. Thirty years ago, even little conferences were arranged with difficulty. There was a stress; there was a feeling of antagonism which the years have gradually worn down. We recognize, for instance, that the Soil Conservation District is an organization that's here; it is doing a job. The Soil Conservation District recognizes that the county agents are doing a job.

There are different ways of approaching such things as a small watershed. If it's small enough, it becomes a problem for the local group, plus the Soil Conservation Service, to handle. If it gets a little bigger, then it goes to the Army Engineers, or it goes to Bureau of Reclamation. There is no difference of opinion as to where it finally will lodge. The Corps of Engineers, on the other hand, will say this project is too small, or it's a big one and is a project that we can handle, or it's a project that might be best handled on the local level.

Congress is still the source of money and there is a situation in the Congress in which the proponents of one of the agencies try to influence Congress to give money to

the agency they work for, either for general operations or for specific projects which are earmarked for agency operations. But, I would say that in most situations there has been a lessening of the tensions and the conflicts between agencies and more of a tendency to look at the problems to see how they might best be solved than was true in the earlier years.

There are probably several reasons for this change. One is that the agencies have become established and more or less fixed. Their function is recognized in the field of general knowledge. For instance, the Extension Service is old, and it's established, and we have grown to recognize that it *is* an established agency. The Soil Conservation Service has been operating since about 1933. It's one of the young agencies, really, but still it has been operating long enough for it to have developed a position. The Bureau of Reclamation dates back to about 1902. The Forest Service began along in the 1900's. They all have a place. They've either been given a certain kind of position by law, or they developed it over a period of time until they have a certain kind of position.

Now, occasionally, there is a twilight zone in which we may be not quite sure who operates, but most of those questions of jurisdiction and so forth have been resolved. There are a few that remain, but there is a tendency among the agencies and among representatives of the general public, to recognize the field of operations of the various agencies. I think that goes back, to quite a degree, to general education.

What do the agencies stand for? And what do they propose to do for us, the people? When an agency enters the field, newly-created by Congress, it must, because congressional legislation can only spell out what it's supposed to do in very broad terms, establish itself, and, in doing so, it fits into the territory with other agencies that are already there. Or it may be developing a program along lines that don't exactly fit into the general scheme.

That was true with the Soil Conservation Service. It was a new developing agency that was involved directly with the farmer. Now, the Bureau of Reclamation and the Army Engineers, they *indirectly* affect you and I or anybody else in an area, but they don't work with the farmer. You see, they have to do with things that affect us, but they don't come to you and say, "Do you want to develop a plan for your operations here?" Somebody else does that. But the Soil Conservation Service, by the nature of its operation, had to get down to the point of contacting the individual who owned land. It meant that it was in direct conflict with the county agent who was supposed to do this thing. Now, the fact that the county agent had certain things that he was trying to get over to the farmer and the Soil Conservation technicians had other things, wasn't recognized in the beginning. The feeling was very strong that if the money which went to the Soil Conservation Service were given to the Extension Service that the Extension Service could do a better job than the Soil Conservation Service could do.

Well, the experience of the Soil Conservation Service in the early years of the old demonstration projects was not very encouraging, to say the least! Many of those efforts were almost failures. Then the idea of the Soil Conservation Districts was thought up. Organized and operated by individual farmers, who, while they might have no money, and on the surface very little influence, nevertheless represented the local interest and had a great deal of power. Indirectly, they had tremendous power. If they didn't like a program that was being suggested for their

people, they didn't approve it. They could rewrite it in terms that they could approve.

If a local farm-plan for an individual farmer contained things which they couldn't approve, they could disapprove those. They could have those things kicked out or they could have them changed. If they didn't like an individual who was assigned to a particular district, they could say, "Get rid of that guy. Get somebody else in we can work with." The district supervisors had, and have still, many powers.

There is an annual work program that has been developed over the years with district supervisors. They say, "Give assistance to this farmer. Don't give assistance to that farmer." Well, the reasons are usually good enough so they'll stand up for arguments. This fellow is ready; that fellow is not. Maybe next year this guy will be ready and next year will be ready to operate, and so forth.

There are many ways in which the district supervisors express the will of their area. After this mechanism was developed, the Soil Conservation Service, began to assume the position of an established service. That is the basis now for the continued operations of the Soil Conservation Service as a national service. No organization has offered the degree of freedom to carry on operations, to accept or reject recommendations that are made to them, in anything like the same degree as the Soil Conservation District does.

Occasionally there is a project that offers some very sticky problems to other agencies. For instance, at the present time we are wrestling with the problem of increasing the water supply of the Colorado River. How should it be done? Where should we look for a supply? How would that supply affect, beneficially we could hope, the areas from which the water might have to be taken? How could the water supply from Columbia River, for instance, be routed through eastern Oregon and Nevada to reach Colorado River? We, as a state, need to know how we could utilize those waters, both from the standpoint of the farm operations and improved recreational features. A little lake in some of the interior valleys in Nevada might be extremely important recreationally. lit might have an influence on the wildlife, the fish and the game around it.

In the broad sense, these are all conservation activities. How do we know how to do these things? We don't, unless we know a lot of basic facts, an understanding of the resources, and so forth, and then have plans for how to develop all those things. Those are all broad aspects of conservation.

Soil Conservation Service has a part to play in this. The State Department of Natural Resources and the State Park System have a part to play in it. The Bureau of Reclamation has a part to play in it. We *all* have parts to play in those things.

And if we were all combined into one great big family—one great big agency—then there'd still be the functions to carry out. There is just as many opportunities for conflict between the functional divisions within a large agency as there is between agencies.

4

Conclusion

How to control or use range lands so that the productive power of the lands can be maintained has been a problem which has bothered people for an infinite period of time. I take it that the story of Cain and Abel in the Book of Exodus in the Bible is the story of the basic conflict or basic difference of interests of the people who farmed the low lands and those who raised livestock on the up lands. If this is actually true, then we may say that the conflict between the irrigation farmer and the users of the range lands has been going on from time immemorial.

I would think that, at the present moment, we know much about what the range lands require, what the grasses and the other types of vegetation require, that was not known to earlier generations. We know, or have a pretty good idea at least, how much grass of each year's growth must remain on the land for the grass to maintain its vigor. We know how to defer grazing and rotate grazing so that the vigor of grasses and the vigor of other types of valuable forages can be maintained. I am personally convinced that research will reveal knowledge that we may need in the future. I am rather optimistic that the methods of management which have been demonstrated to be fruitful in many places will be accepted and put into operation on all of our watersheds. I am optimistic, too, that future generations will recognize the basic facts and be willing to utilize them. I am optimistic that those practices that are necessary for the preservation of the land itself, and the productivity of that land, will be maintained in the future. I am satisfied that on the irrigated areas the private owners will do those things necessary to keep the irrigated lands in a stage of productivity indefinitely. In the final analysis, I am satisfied that, barring outside influences over which the people might have no control, irrigated areas can be very long-lived. In fact, the life of many of our irrigated areas may be practically infinite.

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